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WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: **Metconazole:** Draft Ecological Risk Assessment for Registration Review

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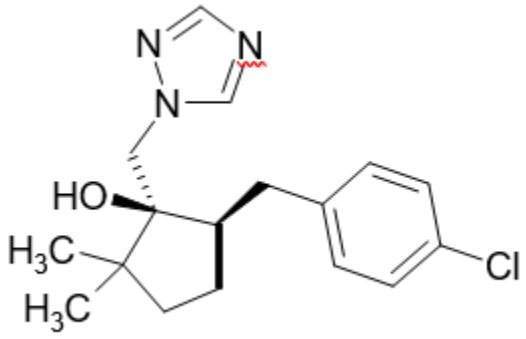
The Environmental Fate and Effects Division (EFED) has completed the draft environmental fate and ecological risk assessment in support of the Registration Review for the fungicide metconazole (CAS 125116-23-6, PC Code 125619).

Draft Ecological Risk Assessment for the Registration Review of Metconazole



CAS No. 125116-23-6
USEPA PC Code: 125619

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1. EXECUTIVE SUMMARY

Metconazole is a broad-spectrum, systemic, triazole fungicide that inhibits spore formation and mycelial growth of fungi. The compound comprises two geometric isomers with a typical ratio of 85 (cis):15 (trans). Metconazole works by inhibiting demethylation and other processes in sterol biosynthesis for the control and suppression of disease. Metconazole agricultural use sites are stone fruits crop group, bushberry crop subgroup, tree nut crop group, tuberous and corm vegetables crop subgroup, rapeseed crop subgroup, dried shelled peas and beans (except soybean), barley, canola, corn, cotton, Filberts (hazelnuts), oats, peanuts, pecans, pistachios, rye, soybeans, sugar beets, sugarcane, triticale and wheat. Metconazole non-agricultural uses include turf grass and ornamentals. According to the Biological and Economic Analysis Division (BEAD), metconazole is formulated as a flowable concentrate (FC), soluble concentrate (SC), emulsifiable concentrate (EC), water dispersible granule (WDG), and a ready to use liquid concentrate (RTU). Foliar applications can be made aerially (except on ornamentals and turf grass) and by ground (broadcast and band). The maximum single application rates range from 0.000026 to 0.6 lbs a.i./A and maximum annual application rates range from 0.113 to 2 lb ai/A with 6- to 14-day application intervals.

1.1 Overview

This draft risk assessment (DRA) analyzes the ecological risks associated with the labeled uses of metconazole to non-Endangered Species Act listed (non-listed), non-target terrestrial and aquatic animals and plants. The assessment is based on the Registration Review Problem Formulation (PF; USEPA 2015; DP 428303), currently available ecotoxicity and environmental fate data, and the most sensitive toxicological endpoints. Since previous assessments were conducted, new ecotoxicity and fate data have been submitted and these data are incorporated into this DRA. The Agency has received and reviewed five new toxicity studies and one fate study since the PF was published. For this assessment, only metconazole is determined to be the residue of concern (ROC), which is consistent with previous risk assessments and the PF.

1.2 Risk Conclusions

This assessment concludes that there are no acute risk concerns for freshwater and estuarine/marine fish and aquatic invertebrates, mammals, piscivorous birds and mammals, adult terrestrial invertebrates, and no risk concerns for growth effects to terrestrial plants. Risk concerns for the following taxa were identified for chronic exposures: birds, mammals, honeybee larvae, freshwater fish (aquatic-phase amphibians), estuarine/marine fish, and freshwater invertebrates. For acute exposure, there is risk of mortality for birds (reptiles,

terrestrial-phase amphibians). There are chronic risk concerns for piscivorous birds and mammals via food chain bioaccumulation. In addition, there are risk concerns for aquatic vascular and non-vascular plants. There was no risk concern identified for fish (aquatic phase amphibians), invertebrates and plants from metconazole use as seed treatments. **Table 1-1** summarizes the RQs and other lines of evidence for metconazole.

Table 1-1. Summary of Risk Quotients (RQs) for Taxonomic Groups from Current Uses of Metconazole

Taxon	Exposure Duration	RQ Range	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
Freshwater fish (aquatic phase amphibians[1])	Acute	0.01 – 0.07	No	---
	Chronic	5.28 – 81.7	**Yes**	RQs exceed the chronic risk LOC of 1 for all uses
Estuarine/ marine fish[1]	Acute	<0.01 – 0.04	No	---
	Chronic	1.39 – 21.6	**Yes**	RQs exceed the chronic risk LOC of 1 for all uses
Freshwater invertebrates[1] (water column)	Acute	<0.01	No	---
	Chronic	0.49 – 7.68	**Yes**	RQs exceed the chronic risk LOC of 1 for most uses except nut, soybean and wheat
Estuarine/marine invertebrates[1] (water column)	Acute	<0.01 – 0.03	No	---
	Chronic	0.26 – 4.03	**Yes**	RQs exceed the chronic risk LOC of 1 for uses on corn, ornamental and turf plants
Freshwater invertebrates[1] (benthic)	Acute	Not calculated	No	Exposure is below level where no mortality was observed
	Chronic	< 0.01	No	---
Estuarine/marine invertebrates[1] (benthic)	Acute	Not calculated	No	Exposure is below level where no mortality was observed
	Chronic	< 0.01	No	---
Mammals	Acute	<0.01 – 0.24	No	---
		0.059-0.12 (dose-based)	No	Acute RQ do not exceeds LOC (0.5) for otter. Risk concern is expected for mammals consuming aquatic fish and invertebrates based on KABAM analysis of bioaccumulation.
	Chronic	0.27 – 19.4 (dose-based)	**Yes**	There are LOC exceedances for all classes except mammals feeding on seeds. The risk concern is low for exposure to treated seed.
		0.14 – 2.24 (dietary based)	**Yes**	There are LOC exceedances for all classes except mammals feeding on fruits/pods/seeds and arthropods. EECs (up to 336 mg a.i./kg-diet) do not exceed the lowest observed adverse effect concentration (LOAEC 750 mg a.i./kg-diet) based on parental (decreased 10-13% body weight and weight gain in F1 females). The risk concern is low for exposure to treated seed.
		36 – 70 (dose-based)	**Yes**	Chronic RQ exceeds LOC (1). Risk concern is expected for mammals consuming aquatic fish and invertebrates based on KABAM analysis of bioaccumulation.
		6.5 – 8.7 (dietary based)	**Yes**	
Birds (surrogate for terrestrial-phase amphibians and reptiles)	Acute	0.01 – 0.68 (dose-based)	**Yes**	Acute RQ exceeds LOC (0.5) for small birds feeding on short grass for turf use only. The dose-based acute risks for birds are expected to be low. The risk concern is low for exposure to treated seed.
		0.08 – 1.35 (dietary based)	**Yes**	Acute RQ exceeds LOC (0.5) with an exception of birds feeding on fruit/pods/seeds for turf use only. No mean Kenaga RQ values exceed LOC (0.5). The dietary-based acute risks for birds are expected to be low. The risk concern is low for exposure to treated seed.

Taxon	Exposure Duration	RQ Range	RQ Exceeding the LOC for Non-listed Species	Additional Information/ Lines of Evidence
		0.007 – 0.12 (dose-based)	No	Acute RQs do exceed LOC (0.5) for dietary-based and only exceeds for sand pipers for dose-based. Risk concern is expected for birds consuming aquatic fish and invertebrates based on KABAM analysis of bioaccumulation.
		0.25 – 0.34 (dietary based)	No	
	Chronic	0.36 – 5.79 (dietary based)	**Yes**	Chronic RQ exceeds LOC (1) with an exception of birds feeding on fruit /pods/seeds. Mean Kenaga RQ values exceed LOC (1) for birds feeding on short grass, broadleaf plants and arthropods. The risk concern is low for exposure to treated seed. Risk concern is expected for birds and mammals consuming aquatic fish and invertebrates based on KABAM analysis of bioaccumulation.
		1.1 – 1.5 (dietary based)	**Yes**	Chronic RQ exceeds LOC (1). Risk concern is expected for birds consuming aquatic fish and invertebrates based on KABAM analysis of bioaccumulation.
Terrestrial invertebrates (using bees as surrogates)	Acute Adult	Not calculated	No (contact)	Exposure is below the level where no mortality was observed. The estimated contact exposure dose (0.73 µg a.i./bee) is two orders of magnitude lower than the non-definitive endpoint (95.3 µg a.i./bee).
		0.1	No (oral)	---
	Chronic Adult	0.79	No	---
	Acute Larval	Not calculated	No	Exposure is below the level where no mortality was observed. The estimated dietary exposure dose (8.7 µg a.i./bee) is one order of magnitude lower than the non-definitive endpoint (101 µg a.i./bee)
	Chronic Larval	1.28	**Yes**	Chronic RQ exceeds LOC (1). There is a chronic risk concern especially because metconazole is a systemic and persistent compound. Chronic effect is based on 28.3% mortality and 10.9% reduced food consumption. Multiple applications may result in residue accumulation in the plant tissues to result in higher exposure potential. The risk concern is low for exposure to treated seed.
Aquatic plants[1]	Vascular	0.7 – 10.9	**Yes**	Based on reduced frond number
	(Non-vascular)	0.19 – 2.95	**Yes**	RQs exceed the chronic risk LOC of 1 for most uses except nut, soybean and wheat. Based on reduced yield
Terrestrial plants	Monocots	-	No	Non-definitive endpoint
	Dicots	<0.1 – 0.29	No	---

Level of Concern (LOC) Definitions: Aquatic animals and terrestrial vertebrates: Acute=0.5; Chronic=1.0; Bees: Acute=0.4; Chronic=1.0; Plants: 1.0

[1]There was no risk concern identified for aquatic vertebrates, invertebrates and plants exposed to metconazole seed treatment.

1.3 Environmental Fate and Exposure Summary

The environmental fate dataset for metconazole is complete. Metconazole has a water solubility limit of 30.4 mg/L. The vapor pressure (1.58×10^{-10} mm Hg) and calculated air-water partition coefficient ($K_{aw} = 8.9 \times 10^{-11}$) indicate a low potential to volatilize from soil and water surfaces. The compound is slightly mobile in soil (mean K_{foc} = 1544 L/kg). With a log octanol-water partition coefficient (log Kow) of 3.85, metconazole may have the potential to

bioconcentrate in aquatic food webs. Measured bioconcentration factors (BCF) in bluegill sunfish are 68X for filet, 128X for whole fish, and 218X for viscera tissues, with a depuration half-life of 1.5-1.7 days.

Metconazole persists in most terrestrial and aquatic environments. The compound is stable to hydrolysis and aerobic and anaerobic aquatic metabolism. The aqueous photolysis half-life is 72 days. Photodegradation in water is not expected to be a major route of dissipation in aquatic systems as metconazole has been shown to partition rapidly to the sediment. Metconazole soil degradation half-lives range from 193 – 630 days. Three major degradates, M30 (13%), M13 (10.9%) and M38 (14.5%), were identified in metconazole environmental fate studies. The degradates are not expected to contribute substantially to exposure because metconazole is slow to degrade in the environment. The residue of concern (ROC) is metconazole only, consistent with previous ecological risk assessments. Extended metconazole use is expected to cause accumulation of residues in soil and water columns from year to year. Major dissipation routes for metconazole are expected to be spray drift and runoff which could potentially contaminate surface water. Terrestrial field dissipation studies indicate metconazole residues were detected to the 15 in soil layer depth and the dissipation half-lives ranged from 60 – 187 days in five bare plots from Canada and the United States.

1.4 Ecological Effects Summary

On an acute exposure basis, metconazole is moderately toxic to freshwater and saltwater fish species; and moderately toxic to highly toxic to water column and sediment invertebrates. On a chronic exposure basis, rainbow trout (*Oncorhynchus mykiss)* and sheepshead minnow *(Cyprinodon variegatus)* exposed to metconazole exhibited signs of toxicity with 14% reduction of fry survival and 9% reduction of dry weight at LOAEC levels 9 and 24 µg a.i./L, respectively.

In invertebrate chronic exposure studies, no effects were observed up to the highest test concentration 59 µg a.i./L with mysid shrimp (*Mysidopsis bahia*) and 24% survival reduction of young adults was observed at 120 µg a.i./L for waterflea (*Daphnia magna*). A new 10-day toxicity study (MRID 50674401) submitted for saltwater sediment-dwelling invertebrates at the test concentration of 10.9 mg a.i./L in pore water produced non-definitive endpoints.

For non-vascular aquatic plants, the most sensitive species is the freshwater diatom (*Navicula pelliculosa*) with an EC_{50} of 87 µg a.i./L. Aquatic vascular plant duckweed (*Lemna gibba)* had lower toxicity endpoints (EC50 = 22 µg a.i./L) than nonvascular plant species.

Metconazole is practically non-toxic to slightly toxic to birds on an acute oral and dietary basis; practically non-toxic to slightly toxic to mammals on an acute oral basis; practically non-toxic to adult honeybees on an acute oral/contact basis; and practically non-toxic to larval honeybees on an acute oral basis. A new dietary study with zebra finch (*Taeniopygia guttata*) was submitted that resulted the most sensitive acute dietary endpoint (LC_{50} =249 mg ai/kg-diet) (MRID 50828601). For chronic exposures to birds, significant reductions in live 3-week embryos, hatching success, and chick survival were noted in northern bobwhite quail. The reported NOAEC and LOAEC values are 58 mg ai/kg diet and 114 mg ai/kg diet, respectively with the LOAEC value based on 43% reduction in hatching eggs and 49% reduction in hatching survival chick.

For chronic exposures to mammals, the most sensitive dose-based NOAEC is 9.79 mg/kg/day and LOAEC is 49.4 mg/kg/day (or 750 mg a.i./kg-diet) based on decreased 10-13% body weight and weight gain in F1 females.

For terrestrial invertebrates, honeybee (*Apis mellifera*) is used as a surrogate species. Three new honeybee studies were submitted, an adult honeybee 10-day dietary study which reported a NOAEL value of 5.43 µg ai/bee/day and a LOAEL of 11.1 µg ai/bee/day based on 28.3% mortality and 10.9% reduced food consumption; a 72-hour oral and dietary acute larval bee study with reported LD_{50} of >101 µg ai/larva and a 22-day chronic dietary larval bee study with a reported NOAEL value of 2.9 µg ai/larva/day and a LOAEL value of 5.8 µg ai/larva/day based on 27% reduced adult emergence.

For terrestrial plants, the most sensitive species with respect to seedling emergence was ryegrass (EC_{25} = 0.78 lb a.i./A) and radish (EC_{25} = 0.15 lb a.i./A). In terms of effects on vegetative vigor, no signs of toxicity were observed at application rates up to the maximum single application rate 0.6 lb a.i./A, therefore, an EC_{25} could not be established for monocot species. For dicot species, the most sensitive species is radish with an EC_{25} of 0.44 lb a.i./A.

1.5 Identification of Data Gaps

The ecological effects and environmental fate dataset for metconazole is adequate. At this time, higher tier pollinator studies and sediment-dwelling invertebrate chronic toxicity studies have not been submitted. The need for the higher tier pollinator studies (required by the registration review DCI), was to be determined by EPA based on the results of lower-tiered tests and/or other lines of evidence, and the need for a refined pollinator risk assessment.

2. INTRODUCTION

This Draft Risk Assessment (DRA) examines the potential ecological risks associated with labeled uses of metconazole on non-target organisms that are not listed as Federally threatened or endangered ("listed") species. This DRA uses the best available scientific information on the use, environmental fate and transport, and ecological effects of metconazole. The general risk assessment methodology is described in the *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs* ("Overview Document") (USEPA, 2004). Additionally, the process is consistent with more recent guidance documents produced by the Environmental Fate and Effects Division (EFED) as appropriate. When necessary, risks identified through standard risk assessment methods are further refined using available models and data.

3. PROBLEM FORMULATION UPDATE

The purpose of the problem formulation (PF) is to provide a foundation for the environmental fate and ecological risk assessment being conducted for the labeled uses of the pesticide metconazole. The PF identifies the objectives for the risk assessment and provides a plan for analyzing the data and characterizing the risk. As part of the Registration Review (RR) process, a detailed preliminary PF (USEPA, 2015, DP428303) for this DRA was published to the docket (Review Docket EPA-HQ-OPP-2015-0013-0019) in December 2015. The following sections summarize the key points of the preliminary PF and discuss any differences between the planned analysis outlined in 2015 and the final analysis conducted in this DRA.

The following ecotoxicity studies for metconazole were submitted to the agency in response to the Generic Data Call-in (ID # GDCI-125619-1611, 2016). The classification of each study is indicated.

- 850.2200 – Avian acute dietary toxicity (TGAI) (MRID 50828601, **Acceptable**)
- 850-1740 - 10-d Whole sediment sub-chronic *Leptocheirus plumulosus* (TGAI) (MRID 50674401, **Acceptable)**
- SS-1253 – Larval honeybee chronic oral toxicity (TGAI) (MRID 50200403, **Supplemental**)
- SS-1254 – Adult honeybee chronic oral toxicity (TGAI) (MRID 50154601, **Acceptable**)
- SS-1257 – Acute oral toxicity – honeybee larvae (TGAI) (MRID 50200404, **Acceptable**)

The following metconazole ecotoxicity studies, all required by the registration review DCI, have not been submitted to the agency

- 850.2100 – Avian acute oral toxicity (TGAI) (Received 850.2200 above as replacement)

- 850.3040 – Field testing for pollinators (TEP) (requirement based on lower Tiered bee test)
- SS-1242 – Whole sediment chronic toxicity – *Chironomus dilutus* (TGAI) (based on sub-chronic test)
- SS-1243 – Whole sediment chronic toxicity – *Hyalella azteca* (TGAI) (based on sub-chronic test)
- SS-1244 – Whole sediment chronic toxicity – *Leptocheirus plumulosus* (TGAI) (based on sub-chronic test)
- SS-1319 – Semi-field testing for pollinators (TEP or TGAI) (tunnel or colony feeding studies -requirment based on low Tiered test)
- SS-1353 – Residues in pollen and nectar (TEP) (requirement based on low Tiered test)

More specific information related to eco-toxicity data are available in **Section 6**

The following environmental fate study for metconazole and its degradates were received and reviewed:

- 850.6100 Environmental Chemistry Method (water) (MRID 50200402, **Acceptable**)

More specific information related to environmental fate data are available in **Section 5**.

The environmental fate and ecotoxicity data that were submitted in response to the DCI were used in developing the current risk assessment.

3.1 Mode of Action for Target Pests

Metconazole is a broad-spectrum, systemic, triazole fungicide that inhibits spore formation and mycelial growth of fungi. Metconazole works by inhibiting demethylation and other processes in sterol biosynthesis. Since it is systemic it is quickly absorbed and can move up into plant tissue. The active ingredient of metconazole includes two geometric isomers (*cis*) and (*trans*). There are no independent toxicity data available for the two geometric isomers. Therefore, this RA includes the racemic mixture to estimate risk exposure.

3.2 Label and Use Characterization

3.2.1 Use Patterns

Metconazole is used in agricultural and non-agricultural settings. The PLUS report (USEPA, 2019a) was used as the source to summarize representative uses for this DRA. Metconazole agricultural use sites are the stone fruits crop group, bushberry crop subgroup, tree nut crop group, tuberous and corm vegetables crop subgroup, rapeseed crop subgroup, dried shelled peas and beans (except soybean), barley, canola, corn, cotton, Filberts (hazelnuts), oats, peanuts, pecans, pistachios, rye, soybeans, sugar beets, sugarcane, triticale and wheat. Metconazole non-agricultural uses include turf, grass and ornamentals. **Table 3-1** summarizes the use patterns of maximum exposure for the agricultural use sites. For foliar applications, the maximum single use rates range from 0.0563 (soybean) to 0.6 lbs a.i./A (turf). The annual number of allowable foliar applications (or those assumed based on single use rates and yearly maximum use rates) range from 1 (rapeseed subgroup) to 8 (ornamentals) per year. For seed treatment, the maximum single use rates range from 0.000026 lb a.i./lb seed to 0.00302 lb a.i./lb seed.

There are 10 active labels for metconazole (EPA Reg. #'s 7969-246;7969-264;7969-291;59639-144;59639-147;59639-171;59639-181;59639-182;59639-218;59639-227). Metconazole has five types of formulated products, flowable concentrate (FC), soluble concentrate (SC), emulsifiable concentrate (EC), dry water dispersible granule (WDG), and a ready to use liquid concentrate (RTU). Foliar application methods include aerial and ground broadcast and airblast. Metconazole is also used as a seed treatment for several crops such as: canola, corn, cotton, oats, triticale and wheat. It should be noted that EPA Reg. # 59639-144 prohibits aerial application. In addition, EPA Reg. #s 59639-144, 56939-144, and 59639-227 are not allowed for use in California.

For use on ornamentals and turf grass the label does not specify the maximum single allowable applications per cycle year, so it is assumed 8 single applications are allowed per cycle year for ornamentals and 4 single applications for turf with one application rate at 0.2 lbs a.i./A to reach the labeled allowable annual maximum application of 2.0 lbs a.i./A.

Table 3-1. Use Patterns and Applications for Metconazole

Use Site	Application Method[1]	Maximum Single Use Rate (lbs a.i./A)	Maximum # of Uses Per (Season) Year[2]	Minimum Application Interval (Days)	Maximum Annual Use Rate (lbs a.i./A/Year)	Comments
Agricultural Use Sites						
12-12. Stone fruit group	Broadcast A & G	0.125	3	7	0.375	---
13-07B. Bushberry subgroup	Broadcast A & G	0.0781	3	7	0.234	---

Use Site	Application Method[1]	Maximum Single Use Rate (lbs a.i./A)	Maximum # of Uses Per (Season) Year[2]	Minimum Application Interval (Days)	Maximum Annual Use Rate (lbs a.i./A/Year)	Comments
14-12. Tree nut group	Broadcast A & G	0.109	4	7	0.438	---
1C. Tuberous and corm vegetables subgroup	Broadcast A & G	0.125	4	7	0.5	---
20A. Rapeseed subgroup	Broadcast A & G	0.125	1	NS	0.125	---
6C. Dried shelled pea and bean (except soybean) subgroup	Broadcast A & G	0.125	2	7	0.25	---
Barley	Broadcast A & G	0.0996	NS	6	NS	---
	Seed treatment	0.000026 lb ai/lb seed	NS	NS	NS	---
Canola	Seed treatment	0.000026 lb ai/lb seed	NS	NS	NS	---
Corn	Broadcast A & G	0.082	6	7	0.352	---
	Seed treatment	0.00015 lb ai/lb seed	NS	NS	NS	---
Cotton	Broadcast A & G	0.082	3	7	0.246	---
	Seed treatment	0.000104 lb ai/lb seed	NS	NS	NS	---
Filbert (hazelnut)	Broadcast A & G	0.109	4	10	0.438	---
Oats	Broadcast A & G	0.0997	2	6	0.1994	---
	Seed treatment	0.000026 lb ai/lb seed	NS	NS	NS	---
Peanuts	Broadcast A & G	0.125	4	14	0.5	---
Pecan	Broadcast A & G	0.109	4	7	0.438	---
Pistachio	Broadcast A & G	0.125	4	14	0.5	---
Rye	Broadcast A & G	0.0996	2	6	0.199	---
Soybeans	Broadcast A & G	0.0563	2	10	0.113	---
Sugar beet	Broadcast A & G	0.0996	2	14	0.199	---
	Seed treatment	0.000302 lb ai/lb seed	NS	NS	NS	---
Sugarcane	Broadcast	0.0719	4	14	0.288	---

Use Site	Application Method[1]	Maximum Single Use Rate (lbs a.i./A)	Maximum # of Uses Per (Season) Year[2]	Minimum Application Interval (Days)	Maximum Annual Use Rate (lbs a.i./A/Year)	Comments
	A & G					
Triticale	Broadcast A & G	0.0996	2	6	0.199	---
	Seed treatment	0.000026 lb ai/lb seed	NS	NS	NS	---
Wheat	Broadcast A & G	0.0996	2	6 d	0.199	---
	Seed treatment	0.000026 lb ai/lb seed	NS	NS	NS	---
Non-Agricultural Use Sites						
Ornamentals (Residential)	Broadcast G	0.272	8[3]	14 d	2.0	Not allowed for use in California
Turf/Grass (Residential and Golf course)	Broadcast G	0.6	4[3]	14 d	2.0	Not allowed for use in California

[1] Application: post emergence, except ornamentals, grass and turf with application based on pest pressure; A = aerial, G = ground (either broadcast or airblast), NS – Not Specified, NA – Not Applicable

[2] Maximum number of applications = maximum sequential applications

[3] Label does not specify the number of maximum single applications per cycle year, so it is assumed 8 single applications are allowed per cycle for ornamentals and 4 single applications for turf with one application at 0.2 lbs a.i/A to reach a maximum of 2.0 lbs a.i./A were modeled to generate EECs.

3.2.2 Usage Summary

The November 2019 Screening Level Usage Analysis (SLUA) developed by the Biological and Economic Analysis Division (BEAD) (USEPA 2019) reports that the largest agricultural usage in terms of pounds of active ingredient applied per year from 2008 to 2017 was on corn (200,000 Lbs), winter and spring wheat (60,000 lbs), tree nuts (almonds (20,000 lbs), pistachios (8,000 lbs), and walnuts (3000 lbs)), sugar cane (4,000 lbs), blueberries (3,000 lbs), cotton (1000 lbs), peanuts (500 lbs) and potatoes (500 lbs). An average of <500 lbs of metconazole per year is applied to apricots, cherries, dry beans/peas, hazelnuts, nectarines, peaches, pecans, plums/prunes, soybeans, sugar beets. (**Table 3-2**).

Table 3-2. Screening Level Estimates of Agricultural Uses of Metconazole for 2007-2019[1]

Crop	Annual Average Applied (lbs a.i.)	Percent Crop Treated	
		Average	Maximum
Corn	200,000	5	10
Wheat, Spring	30,000	5	10
Wheat, Winter	30,000	<2.5	5

Crop	Annual Average Applied (lbs a.i.)	Percent Crop Treated	
		Average	Maximum
Almonds	20,000	25	30
Pistachios	8,000	20	30
Sugarcane	4,000	10	20
Blueberries	3,000	30	40
Walnuts	3,000	10	15
Cotton	1,000	<1	<2.5
Sweet Corn	1,000	5	20
Peanuts	500	<1	<2.5
Potatoes	500	<1	<2.5
Apricots	<500	10	20
Cherries	<500	<2.5	5
Dry Beans/Peas	<500	<1	<2.5
Hazelnuts	<500	<2.5	<2.5
Nectarines	<500	NC	NC
Peaches	<500	<2.5	5
Pecans	<500	<1	<2.5
Plumes/Prunes	<500	<2.5	5
Soybeans	<500	<1	<2.5
Sugar Beets	<500	5	10

[1]USEPA 2019

3.2.3 Label Uncertainties

Missing use directions on some labels introduce uncertainty in how the pesticide may be applied to agricultural use sites when following those labels. For metconazole, EPA Reg. # 59639-144 allows a maximum single drench application of 4oz/100-gal dilution and a finished spray of 2 pt/sq.ft. This maximum single drench application was extrapolated to be 13.61 lb a.i./A based on label directions for ornamental use, however the drench application is targeted at each plant base and is considered a spot treatment. For ornamental use, the label (EPA Reg. # 59639-144) has a yearly restriction of 2 lb a.i./A.

4. RESIDUES OF CONCERN

Metconazole (parent compound alone) is the residue of concern (ROC) for both terrestrial and aquatic organisms in the ecological risk assessment. Three major degradates (M13, M30 and M38) were reported in submitted in environmental fate studies (**Appendix A**). In general, the degradates are not expected to contribute substantially to exposure or modify risk conclusions,

in part, because metconazole is slow to degrade in the environment. For example, although M30 was a major degradate in an aerobic soil laboratory study (up to 13% of the applied dose), a previous assessment concluded that risk conclusions would not change if M30 were included in the exposure estimates (USEPA, 2011 DP 386426+). This ROC determination is consistent with that of all previous ecological risk assessments for metconazole.

5. ENVIRONMENTAL FATE SUMMARY

5.1 Physical-Chemical, Sorption, and Bioconcentration Properties

The physical, chemical, and transport properties of metconazole are summarized in **Table 5-1**. Metconazole has a water solubility limit of 30.4 mg/L. With a vapor pressure of 1.58 x 10^{-10} mm Hg (25°C), the compound has a low potential to volatilize under dry field conditions and from water surfaces (K_{AW} of 8.9 x 10^{-11}). It has a pKa value of 11.38, indicating that the molecule will not dissociate under environmental conditions. The organic carbon normalized-Freundlich adsorption coefficients (K_{foc}) are an appropriate descriptor of soil sorption. With a mean K_{foc} value of 1544 L/kg (range from 1026 to 2723 L/Kg), metconazole is slightly mobile in soil. Metconazole could potentially contaminate surface water through spray drift, runoff, and has low potential to leach into groundwater. Based on a log K_{OW} of 3.85 and being stable in aquatic environment, metconazole has the potential to bioconcentrate in aquatic food webs. Measured bioconcentration factors (BCF) in bluegill sunfish are 68X for filet, 128X for whole fish, and 218X for viscera tissues, with a depuration half-life of 1.5-1.7 days (MRID 46808425).

Table 5-1. Metconazole Physical-Chemical, Sorption, and Bioconcentration Properties

Parameter	Value[1]	Source/ Study Classification/ Comment
Molecular Weight (g/mole)	319.8	MRID 46808404 Supplemental
Water Solubility at 20°C, pH 7 (mg/L)	30.4	
Vapor Pressure at 25°C (torr)	1.58 X 10^{-10}	
pKa	11.38	
Henry's Law constant at 25°C (atm m^3/mol)	2.9 x 10^{-12}	Calculated using vapor pressure, molecular weight and water solubility HLC = VP (torr) x (1 atm/760 torr) x MW (g/mol) x 1 (mg m^3 /g L)/ WS (mg/L)

Parameter	Value[1]			Source/ Study Classification/ Comment
Air/Water Partition Coefficient (Kaw) (unitless)	8.9×10^{-11}			Calculated using Henry's law constant Kaw = HLC (atm m^3/mol)/[R (atm m^3/mol K) x T (K)]
Log Octanol-water partition coefficient (log K_{ow}) at 25°C (unitless)	3.85			MRID 46808404 (Flash shaking method)
Soil-Water Distribution Coefficients (K_F in L/kg-soil or sediment) Organic carbon normalized distribution coefficients (K_{FOC} in L/kg-organic carbon)	**Soil/ Sediment**	**K_F**	**K_{FOC}**	MRID 46808411 Supplemental; slightly mobile (FAO classification system); K_{FOC} better descriptor of sorption based on lower CV.
	Sandy loam	6.32	2723	
	Clay loam	32.98	1115	
	Silt loam	13.09	1026	
	Sand	8.37	1312	
	Mean	15.2	1544	
	CV	0.80	0.51	
Steady State Fish Bioconcentration Factor (BCF in L/kg-wet weight)	**Species**	**BCF**	**Depuration**	MRID 46808425 Acceptable
	Bluegill Sunfish *Lepomis macrochirus*	68X- fillet 128X whole 218X viscera	Depuration DT_{50} = 1.5-1.7 days	

CV=Coefficient of Variation

[1]All estimated values were calculated according to "Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments" (USEPA, 2010a).

5.2 Environmental Fate

Table 5-2 summarizes representative degradation half-life values from laboratory studies of metconazole. Metconazole is stable to hydrolysis, aerobic aquatic metabolism, and anaerobic aquatic metabolism. It is moderately to slightly degradable by direct photolysis in water (half-life of 72 days). However, photodegradation in water is not expected to be a major route of dissipation in aquatic systems as metconazole has been shown to partition rapidly to sediment.

The aerobic soil half-life values range from 193 days to 630 days based on three soil metabolism studies of six soils. In a soil photolysis study, metconazole degraded with an estimated half-life of 50-140 days. Adsorption/desorption studies indicate metconazole is slightly mobile (FAO, 2000) in four soils (pH 5.8-7.6, 0.74-2.29 % OC), with K_{OC} values ranging between 1026 and 2723 ml/g. Three major degradates were identified in three metconazole environmental fate studies, aquatic photolysis, aerobic aquatic and aerobic soil metabolism. They are M30 (13%), M13 (10.9%) and M38 (14.5%). Unextracted residues were not detected in submitted fate studies. **Appendix A** lists the chemical names, structures, and the maximum percent formation of the degradates.

Table 5-2. Summary of Metconazole Environmental Fate Data

Parameters	Value and Unit	Source/Study Classification /Comment
Hydrolysis ($t_{1/2}$ at pH 5, 7 and 9)	stable	MRID 46808404, acceptable MRID 46902201, acceptable
Aqueous Photolysis ($t_{1/2}$ at pH 5,7, and 9)	72 days	46902202, acceptable
Soil Photolysis ($t_{1/2}$)	140 days 50 days	MRID 46808406, acceptable 46902203, acceptable
Aerobic Soil Metabolism ($t_{1/2}$ at 25 °C) (SFO) Sandy loam, pH 6.2-7.4 Clay soil, pH 6.6 Silty clay loam, pH 8.0 Sandy soil, pH 6.0	630 days, Sandy loam 257 days, Clay soil 267 days, Sandy loam 193 days, Silty clay loam 204 days, Sandy loam 578 days, Sand soil	MRID 46808408, acceptable MRID 46902204, supplemental MRID 46970901, supplemental
Aerobic Aquatic Metabolism ($t_{1/2}$ at 20 °C)	Stable (990 days)	MRID 46902205, acceptable
Anaerobic Aquatic Metabolism ($t_{1/2}$ at 20 °C)	Stable 120 days (SFO) (Water: sandy loam) 360 days (SFO) (Water: clay sediment)	MRID 46808409, supplemental MRID 46808410, acceptable

SFO = single first order; SFO DT_{50}=single first order half-life;
DFOP = double first order in parallel; DFOP slow DT_{50}=slow rate half-life of the DFOP fit,
IORE = indeterminate order (IORE); T_{IORE}=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit

5.3 Field Dissipation

A summary of terrestrial field dissipation data is provided in **Table 5-3**. Metconazole field dissipation half-lives (DT_{50}) ranged from 60 to 187 days and the residues were detected at a lowest depth of 15 in at five bare plot sites in Canada and the United States. While field dissipation studies are designed to capture a range of loss processes; laboratory studies are designed to capture loss from one process (*e.g.*, hydrolysis, aerobic metabolism, *etc*.). There were no transformation products identified in the field dissipation studies greater than 10% of the applied. The degradation rates from laboratory aerobic soil studies were slower than the rates from the field dissipation studies.

Table 5-3. Summary of Field Dissipation Data for Metconazole

System Details	DT_{50} (days)	Max Detected Leaching Depth (inches)	Source/ Classification/ Comment
	Metconazole		
Canada Clay Loam	120 (SFO-LN)	7.5	MRID 46901702 Acceptable
CA Sandy Loam	60 (SFO-LN)	7.5	MRID 46901703 Acceptable
OK Loamy Sand	187 (SFO-LN)	15	MRID 46902206 Acceptable
MS Silt Loam	94 (SFO-LN)	15	MRID 46902207 Acceptable
ND Loam	148 (SFO-LN)	15	MRID 4692208 Acceptable

SFO-LN indicates Single First Order based on natural log transformation

6. ECOTOXICITY SUMMARY

Consistent with the process described in the Overview Document (USEPA, 2004), the risk assessment for metconazole relies on a surrogate species approach. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate the potential effects on a variety of species (receptors) included under these taxonomic groupings. The ecotoxicity data for metconazole and its formulated products have been discussed previously in several ecological risk assessments (USEPA 2014b, D418957+; USEPA 2011a, D386426+; USEPA 2011b, D3755776+; USEPA 2008a, D351386; USEPA 2008b, D350275; USEPA 2008c, D341707 and USEPA 2007, D331927) and in a Problem Formulation (PF) for Registration Review (USEPA 2015, D428303). Registrant-submitted toxicity data are available for both the technical grade active ingredient (TGAI) and typical end-use products (TEP) for some taxa. These data are summarized in the PF. The new studies and the studies with the most sensitive endpoints are summarized in **Sections 6.1 and 6.2**. Five studies with animals exposed to the TGAI were received since the Problem Formulation was issued in 2015 (USEPA 2015, D428303). The results of these studies are described briefly in this section.

Under the Food Quality Protection Act (FQPA), EPA is required to screen pesticides for their potential to produce effects similar to those produced by estrogen in humans and gives EPA the authority to screen certain other chemicals and to include other endocrine effects. In response, EPA developed the Endocrine Disruptor Screening Program (EDSP). Metconazole is not on the list to be screened and additional information on the Endocrine Disruptor Screening Program is available in **Appendix B**.

6.1 Aquatic Toxicity

The most sensitive toxicological endpoints for aquatic organisms are included in this section. A new 10-day acute toxicity study (MRID 50674401) was submitted after the PF for saltwater sediment-dwelling invertebrates which provides non-definitive endpoint (LC_{50} > 10.9 mg ai/L) for pore water.

Acute Exposure

Metconazole is moderately toxic to freshwater and saltwater fish and moderately toxic to highly toxic to aquatic invertebrates. For aquatic plants, the most sensitive non-vascular plant species is the freshwater diatom (*Navicula pelliculosa*) with an EC_{50} of 87 µg a.i./L. Metconazole is slightly more toxic to the aquatic vascular plants, duckweed (*Lemna gibba*) with an EC_{50} of 22 µg a.i./L, than that of non-vascular plant species.

Chronic Exposure

Rainbow trout (*Oncorhynchus mykiss)* and sheepshead minnow *(Cyprinodon variegatus)* exposed to metconazole on a chronic basis exhibited signs of toxicity with 14% reduction of fry survival and 9% reduction of dry weight at LOAEC levels 9 and 24 µg a.i./L, respectively.
In a chronic test, growth and reproductive effects were not observed in mysid shrimp (*Mysidopsis bahia*) at a LOAEC of >59 µg a.i./L. For waterflea (*Daphnia magna*), 24% survival reduction of young adult was found at a LOAEC level of 120 µg a.i./L. For sediment invertebrates, a new 10-day sub-chronic toxicity study (MRID 50674401) was submitted after the PF for saltwater sediment-dwelling invertebrates. The NOAEC value is 5.73 mg ai/L for pore water and the LOAEC is 10.9 mg ai/L, based on 26% decrease in dry weight.

The most sensitive endpoints for aquatic organisms are included in **Table 6-1**. These bolded endpoints are used to derive RQs.

Table 6-1. Summary of Aquatic Organism Toxicity Endpoints for Metconazole Used in this Assessment

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID/ Classification	Comments
Freshwater Fish (surrogates for vertebrates)					
Acute 850.1075	TGAI (90.3%)	Common carp (*Cyprinodon variegatus*)	LC_{50}= **3300**	47777001 Acceptable	Moderately Toxic; an acute study is available for rainbow trout (MRID 47796001) with a similar LC50 (5400 µg a.i./L)

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value in µg a.i./L (unless otherwise specified)	MRID/ Classification	Comments
95-d Chronic (ELS) 850.1400	TGAI (97.4%)	Rainbow trout (*Oncorhynchus mykiss*)	NOAEC = **2.9** LOAEC = 9.0	46902213 Acceptable	Based on 14% reduction of fry survival
Estuarine/marine Fish (Surrogates for vertebrates)					
Acute 850.1075	TGAI (98.7%)	Sheepshead Minnow *Cyprinodon variegatus*	LC_{50}=**6300**	46808422 Acceptable	Moderately Toxic
33-d Chronic (ELS) 850.1400	TGAI (99.4%)		NOAEC = **11** LOAEC = 24	47795004 Acceptable	Based on reduced 9% dry weight and 3% length
Freshwater Invertebrates					
Acute 850.1010	TGAI (99.4%)	Waterflea *Daphnia magna*	EC_{50}= **5900**	47795002 Acceptable	Moderately Toxic; effect based on immobility
Full Lifecycle 850.1300	TGAI (99.4%)		NOAEC = **31** LOAEC = **120**	47795005 Acceptable	Based on 24% survival reduction of young adult
Estuarine/ marine invertebrates					
Acute 850.1035	TGAI (98.7%)	Mysid shrimp *Mysidopsis bahia*	LC_{50}=**780**	46808421 Supplemental	Highly toxic
Chronic 8501350	TGAI (99.7%)		NOAEC = **59** LOAEC > 59	48221501 Acceptable	No effects to reproduction, length or weight observed at highest test concentration
10-d Whole sediment sub-chronic 850.1740	TGAI (98.3%)	Saltwater Amphipod (*Leptocheirus plumulosus*)	OC-Normalized Sediment (mg ai/kg-OC) NOAEC: 12,000 LOAEC: 24,000 LC_{50}: >24,000 Pore Water (mg ai/L) NOAEC: 5.73 LOAEC: 10.9 LC_{50}: >10.9	50674401[N] Acceptable	26% decrease in dry weight at the LOAEC level 10.9 mg ai/L
Aquatic vascular and non-vascular plants					
Vascular 850.4400	TGAI (97.9%)	Duckweed *Lemna gibba*	EC_{50} = **22**	46808428 Acceptable	(Based on reduced frond number)
Non-vascular 850.4500	TGAI (98.7%)	Freshwater diatom (*Navicula pelliculosa*)	EC_{50} = **87**	46808431 Acceptable	(Based on reduced yield)

TGAI=Technical Grade Active Ingredient
TEPs= typical end use products
ELS = early life stage
Bolded values are the most sensitive endpoints used in the modeling, TGAI value is used in case of similar toxicity.

> Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA 2011)

6.2 Terrestrial Toxicity

The most sensitive toxicological endpoints for terrestrial organisms exposed to metconazole are included in **Table 6-2**. These values are used to derive RQs. Additional information on these studies is discussed below including new studies submitted after data call-in. Information on other endpoints can be found in the problem formulation (USEPA 2015, DP 428303). A dietary study with the zebra finch (*Taeniopygia guttata*) was submitted and reported the most sensitive acute dietary endpoint (LC_{50} =249 mg ai/kg-diet) (MRID 50828601). Three new honeybee studies were submitted, an adult honeybee 10-day dietary study with a reported NOAEL value of 5.43 µg ai/bee/day and a LOAEL of 11.1 µg ai/bee/day based on 28.3% mortality and 10.9% reduced food consumption (MRID 50200403); a 72-hour oral and dietary acute larval bee study with reported LD_{50} (>101 µg ai/larva) (MRID 50200404); and a 22-day chronic dietary larval bee study with a reported NOAEL value of 2.9 µg ai/larva/day and a LOAEL value of 5.8 µg ai/larva/day based on 27% reduced adult emergence (MRID 50154601).

Acute Exposure

Metconazole is practically non-toxic to slightly toxic to birds on an acute oral and dietary basis. A dietary study with zebra finch (*Taeniopygia guttata*) was submitted since PF. The reported dietary endpoint (LC_{50} =249 mg ai/kg-diet) (MRID 50828601) from this study was used to replace the previous dietary endpoint from bobwhite quail (LC_{50} =1078 mg ai/kg-diet) study (MRID 46808414). Metconazole is practically non-toxic to slightly toxic to mammals on an acute oral basis. For terrestrial invertebrates, a new 72-hour oral and dietary acute larval bee study has reported LD_{50} (>101 µg ai/larva) (MRID 50200404). Metconazole is practically non-toxic to adult and larval honeybees with non-definitive endpoints on an acute contact basis.

For terrestrial plants, the most sensitive species with respect to seedling emergence were ryegrass (EC_{25} = 0.78 lb a.i./A) and radish (EC_{25} = 0.15 lb a.i./A). In terms of effect on vegetative vigor, no signs of toxicity were observed at the application rates up to 0.6 lb a.i./A and an EC_{25} could not be established for monocot species. For dicot species, the most sensitive species is radish with an EC_{25} of 0.44 lb a.i./A. No new data were submitted for terrestrial plants.

Chronic Exposure

For chronic exposures to birds, significant reduction in live 3-week embryos, hatching success (43% reduction), chick survival (49% reduction), chick body weights, and adult female body weight gain were noted in northern bobwhite quail. Decreased body weight and weight gain,

increased incidence of fatty hepatocyte change, and increased incidence of spleen congestion, increased gestation length and dystocia, and decreased viability on lactation day 0 and decreased body weight in F2 offspring were noted in rats.

Two new chronic honeybee studies were submitted, an adult honeybee 10-day dietary study with a reported NOAEL value of 5.43 µg ai/bee/day and a LOAEL of 11.1 µg ai/bee/day based on 28.3% mortality and 10.9% reduced food consumption (MRID 50200403); and a 22-day chronic dietary larval bee study with a reported NOAEL value of 2.9 µg ai/larva/day and a LOAEL value of 5.8 µg ai/larva/day based on 27% reduced adult emergence (MRID 50154601).

Formulation Toxicity

Effects data are available for two metconazole formulations: BAS 556 UG F containing 12.1 % pyraclostrobin and 7.37% metconazole and BAS 556 02 F containing 13.4% pyraclostrobin and 5.17% metconazole. The available effects data indicate that metconazole in combination with these other active ingredients is of similar toxicity as TGAI for mammals. Three toxicity studies with formulations including just the active ingredient metconazole indicate that, for acute effects to mammals, metconazole formulations are not more toxic than the TGAI alone (USEPA 2011, DP386426+).

Endpoints used for modeling for terrestrial organisms are included in **Table 6-2**.

Table 6-2. Summary of Terrestrial Organism Toxicity Endpoints for Metconazole Used in Assessment

Study Type	Test Substance (% a.i.)[1]	Test Species	Toxicity Value	MRID Classification	Comments
Birds (surrogates for terrestrial amphibians and reptiles)					
Acute Oral 850.2100	TGAI (97.9%)	Bobwhite quail (*Colinus virginianus*)	LD_{50} = **777** mg ai/kg-bw	46808413 Acceptable	
Acute Dietary 850.2200	TGAI (98.3%)	Zebra finch (*Taeniopygia guttata*)	LC_{50} = **249** mg ai/kg-diet	50828601[N] Acceptable	
Chronic 850.2300	TGAI (97.9%)	Bobwhite quail (*Colinus virginianus*)	NOAEC = **58** mg ai/kg diet LOAEC = 114 mg ai/kg diet	46808416 Acceptable	Based on 43% reduction in hatching eggs and 49% reduction in hatching survival chick
Mammals					
Acute Oral 850.2400	TGAI (95 %)	Laboratory Mouse *(Mus musculus)*	LD_{50} = **595** mg a.i./kg-bw (female)	44721512 Acceptable	Moderate toxic for a 22 g mouse

Study Type	Test Substance (% a.i.)[1]	Test Species	Toxicity Value	MRID Classification	Comments
Chronic (2-generation reproduction) 850. 2350	TGAI (98.99%)	Rat (*Rattus norvegicus*)	Dosed based (mg/kg/day) NOAEC = **9.79** (males) and 10.78 (females) LOAEC = **49.4** (males) and 53.2 (females) Diet based (mg ai/kg diet) NOAEC = **150** LOAEC = **750**	46808447 Acceptable	Based on parental (decreased 10-13% body weight and weight gain in F1 females).
Bees (Adults)					
Adult acute contact 850.3020	TGAI (95.3%)	Adult honeybee (*Apis mellifera L.*)	LD_{50} > **95.3** µg ai/bee	46808426 Acceptable	Practically non-toxic. No mortality at highest test dose.
Adult Acute Oral			LC_{50} = **88** µg ai/bee	46808426 Acceptable	based on mortality
Non-Guideline 10-Day Chronic Feeding Study	TGAI (98.7% w/w)	Adult honeybee (*Apis mellifera*)	Mortality NOAEL: **5.43** µg ai/bee/day LOAEL: 11.1 µg ai/bee/day Food consumption NOAEL: <5.43 µg ai/bee/day LOAEL: 5.43 µg ai/bee/day	50200403 [N] Supplemental (can be used qualitatively in a risk assessment)	LOAEL for based on 28.3% mortality and 10.9% reduced food consumption NOTE: solvent effects on food consumption have impacted the estimation of the LD/LC50 estimates for bee mortality and may, too, have affected food consumption responses.
Non-Guideline Acute Toxicity 72 hours study	TGAI (98.7% w/w)	Larval honeybee (*Apis mellifera*)	LD_{50}: **>101** µg ai/larva	50200404 [N] Acceptable	Practically non-toxic NOTE: Mortality did not exceed 50% at any dose; so, toxicity values were visually estimated based on the measured concentrations and doses. Regression to estimate LD/C50 values was inappropriate given there were no treatments that resulted in mortality rates greater than 36%. No significant mortality observed at 24.8 ug a.i./larva.
Non-Guideline Chronic Toxicity (22-day study)	TGAI (98.7% w/w)	Larval honeybee (*Apis mellifera*)	NOAEL: **2.9 µg** ai/larva/day or 76.7 mg ai/kg diet LOAEL: 5.8 µg ai/larva/day or 151 mg ai/kg diet	50154601[N] Acceptable	Based on 27% reduced adult emergence at LOAEC (5.8 µg ai/larva/day). At the highest tested dose (21 µg ai/larva/day)

Study Type	Test Substance (% a.i.)[1]	Test Species	Toxicity Value	MRID Classification	Comments
Terrestrial plants					
Seedling Emergence (Tier II) 850.4100	TEP Metconazole 50 WDG (51.3%), sole active ingredient	Monocot (4) Onion, *Allium cepa*, Corn, *Zea mays*, Ryegrass, *Lolium perenne,* Wheat, *Triticum aestivum* Dicot (6) Buckwheat, *Fagopyrum sp.*, Flax, *Linum usitatissimum*, Radish, *Raphanus sativus,* Lettuce, *Lactuca sativa*, Soybean, *Glycine max*, Tomato, *Lycopersicum esculentum*	Monocot (ryegrass) EC_{25} = 0.78 lb a.i./A Dicot (radish) EC_{25} = 0.15 lb a.i./A	46805103 Acceptable	The most sensitive monocot and dicot was based on plant height
Vegetative Vigor (Tier II) 850.4150	TEP Metconazole 50 WDG (51.3%), sole active ingredient	Monocot (4) Onion, *Allium cepa*, Corn, *Zea mays*, Ryegrass, *Lolium perenne,* Wheat, *Triticum aestivum* Dicot (6) Buckwheat, *Fagopyrum sp.*, Flax, *Linum usitatissimum*, Radish, *Raphanus sativus,* Lettuce, *Lactuca sativa*, Soybean, *Glycine max*, Tomato, *Lycopersicum esculentum*	Monocot EC_{25} > 0.60 lb a.i./A Dicot (radish) EC_{25} = 0.44 lb a.i./A	46805104 Acceptable	Based on no observed effects (all test species)

[1] TGAI=Technical Grade Active Ingredient, TEP = typical end use product

[2] Bolded values are the most sensitive endpoints used in the modeling

[3] > Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA 2011).

[N] – Recent submitted MRID studies after Data Call-in.

>Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA 2011).

6.3 Incident Data

The Office of Pesticide Programs' Incident Database System (IDS), which includes the ecological incidents recorded and additional incidents in aggregate form reported by the registrant to the

Agency on a quarterly basis, was queried on May 6, 2020. There are 6 ecological incident reports in IDS, 1 is from a registered use, 3 are undetermined legality, 1 is a misuse and 1 is a spill. An Iowa apiary reported that a plane sprayed within 1/4 mile of the hives without warning beekeepers in 2014 (incident number I027332-010), but no bee mortality was noted, and the legality is undetermined. Honeybee mortality was observed in another two undetermined legality incidents after possible exposure to metconazole, but the incidents are classified as "unlikely" to be related to metconazole because insecticides were also present (in one case clothianidin was detected in bee tissue (incident number I027332-004) and in the other case bees may have been exposed to fenpropathrin) (incident number I027112-001). One minor plant incident was reported in the aggregate incident database that involved metconazole and pyraclostrobin in 2016 (incident number I026661-001). No other ecological incidents were reported or confirmed in the databases for metconazole. The number of actual incidents associated with metconazole may be higher than what is reported to the Agency. Incidents may go unreported since side effects may not be immediately apparent or readily attributed to the use of a chemical. Although incident reporting is required under FIFRA Section 6(a)(2), the absence of reports in IDS does not indicate that the chemical has no effects on wildlife; rather, it is possible that incidents are unnoticed and unreported.

7. ANALYSIS PLAN

7.1 Overall Process

This assessment uses a weight-of-evidence approach that relies heavily, but not exclusively, on a risk quotient (RQ) method. RQs are calculated by dividing an estimated environmental concentration (EEC) by a toxicity endpoint (*i.*e., RQ=EEC/toxicity endpoint). This is a way to determine if an EEC is expected to be above or below the concentration associated with the effect endpoint. The RQs are compared to regulatory levels of concern (LOCs). The LOCs for non-listed species are meant to be protective of community-level effects on various taxa. For acute and chronic risks to vertebrates, the LOCs are 0.5 and 1.0, respectively, and the LOC for plants is 1.0. The acute and chronic risk LOCs for bees are 0.4 and 1.0, respectively. In addition to RQs, other available data (*e.g.*, incident data) can be used to help understand the potential risks associated with the use of the pesticide. Risk presumptions, along with the corresponding RQs and LOCs are summarized in **Table 7-1**.

Table 7-1. Risk Presumptions and LOCs

Risk Presumption	RQ	LOC
Birds[1]		
Acute Risk	EEC/LC50 or LD50/ft2 or LD50/day	0.5
Chronic Risk	EEC/NOAEC	1
Wild Mammals[1]		

Acute Risk	EEC/LC50 or LD50/ft2 or LD50/day	0.5
Chronic Risk	EEC/NOAEC	1
Aquatic Animals[2,3]		
Acute Risk	EEC/LC50 or EC50	0.5
Chronic Risk	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants		
Acute Risk	EEC/EC25 or IC25	1
Terrestrial Invertebrates: Honeybees		
Acute Risk	EEC/LC50	0.4
Chronic Risk	EEC/NOAEC	1

[1] LD_{50}/sqft = (mg/sqft) / (LD_{50} * wt. of animal) and
LD_{50}/day = (mg of toxicant consumed/day) / (LD_{50} * wt. of animal)
[2] EEC = (ppm or ppb) in water
[3] Include bioaccumulation LOCs

7.2 Modeling

Various models are used to calculate aquatic and terrestrial EECs. **Table 7.2** gives an outline of these models the agency uses and of those used in this ecological DRA.

Table 7-2. List of the Models Used to Assess Risk

Environment	Taxa of Concern	Exposure Media	Exposure Pathway	Model(s) or Pathway
Aquatic	Vertebrates/ Invertebrates (including sediment dwelling)	Surface water and sediment [5]	Runoff and spray drift to water and sediment	PRZM-VVWM with PWC version 1.52[1]
	Aquatic Plants (vascular and nonvascular)			
Terrestrial	Vertebrate	Dietary items	Ingestion of residues in/on dietary items as a result of direct foliar application	T-REX version 1.5.2[2]
		Consumption of aquatic organisms	Residues taken up by aquatic organisms	KABAM version 1.03[3]
	Plants	Spray drift/runoff	Runoff and spray drift to plants	TERRPLANT version 1.2.2
	Bees and other terrestrial invertebrates	Contact Dietary items	Spray contact and ingestion of residues in/on dietary items as a result of direct application	BeeREX version 1.0
All Environments	All	Movement through air to aquatic and terrestrial media	Spray drift	AgDRIFT™ version 2.1.1 (Spray drift)

[1] The Pesticide in Water Calculator (PWC) is a Graphic User Interface (GUI) that estimates pesticide concentration in water using the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM).
PRZM-VVWM.
[2] The Terrestrial Residue Exposure (T-REX) Model is used to estimate pesticide concentration on avian and mammalian food items.
[3] The Kow based Aquatic Bioaccumulation Model (KABAM) is used to estimate exposure to terrestrial animals that may consume aquatic organisms when a chemical has the potential to bioconcentrate or bioaccumulate. The general triggers for running this model is that: the pesticide is a non-ionic, organic chemical; the Log Kow value is between 3 and 8; and the pesticide has the potential to reach aquatic habitats.

8. AQUATIC ORGANISMS RISK ASSESSMENT

8.1 Aquatic Exposure Assessment

8.1.1 Modeling

Surface water exposure modeling was conducted using the Pesticide in Water Calculator (PWC version 1.52). PWC scenarios are used to specify soil, climatic, and agronomic inputs in the Pesticide Root Zone Model (PRZM) and are intended to result in Estimated Environmental Concentrations (EEC) associated with a crop and pesticide within a geographic region. Each PWC scenario is specific to a vulnerable area where the crop is commonly grown. Soil and agronomic data specific to the location are built into the scenario, and specific climatic weather station data providing 30 years of daily weather values are associated with the location.

Chemical input parameters for modeling metconazole are presented in **Table 8-1**. Input parameters were selected in accordance with EFED's guidance documents (USEPA, 2009b; USEPA, 2010b; USEPA, 2012b; USEPA, 2013a; USEPA, 2013b; USEPA, 2014a; USEPA, 2014b). The daily average value is used to calculate acute RQ values for aquatic organisms rather than the peak value used in previous risk assessments (USEPA, 2017).

Table 8-1. Aquatic Modeling Chemical Input Parameters for Metconazole [1]

Parameter	Input Value and Unit	Comment	Source
Hydrolysis $t_{1/2}$ @25°C, pH 7	0	Stable	MRID 46902201 MRID 46808404
Aerobic Soil Metabolism $t_{1/2}$ @25°C	473 d	Represents the 90th percentile confidence bound on the mean half-life of 6 half-lives of metconazole	MRID 46808408 MRID 46902204 MRID 46970901
Aerobic Aquatic Metabolism $t_{1/2}$ @ 20°C	0	Stable	MRID 46902205

[1] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-selecting-input-parameters-modeling

Parameter	Input Value and Unit	Comment	Source
Anaerobic Aquatic Metabolism $t_{1/2}$ @20°C	0	Stable	MRID 49720903
Aquatic Photolysis $t_{1/2}$ @ 40°N sunlight	72 d	--	MRID 46902202
Vapor Pressure @ 25°C	1.58×10^{-10} mmHg		MRID 46808404
Solubility in Water, pH 7 @20°C	30.4 mg/L	Product chemistry data	MRID 46808404
Molecular Mass	319.8 g/mol	Product chemistry data	MRID 46808404
Soil-water Partition Coefficient (K_{FOC})	1544 L/kg	Represents the average K_{FOC} of 2723, 1115, 1026, 1312 L/kg; K_{FOC} c.v. less than K_F c.v.	MRID 46808411

The majority of uses for metconazole allow aerial and ground broadcast applications. The uses on ornamental and turf/grass allow only ground applications. Agricultural uses were modeled as aerial applications to assess the greater spray drift from those applications than from ground spray or airblast applications. Only one seed treatment scenario is modeled because the EECs are expected to be a magnitude less than the EECs from other application methods for aquatic exposure. The allowable label application methods were modeled utilizing the PWC model.

Table 8-2 represents the application scenarios and crop input parameters used to generate the EECs for each crop site. The initial application date is +30 days and -14 days after emergence and post emergence to reflect foliar applications and seed treatments, respectively.

Table 8-2. Pesticide in Water Calculator (PWC) Input Parameters Specific to Selected Maximum Use Patterns for Metconazole

Run Name [A]	Use Site	PWC Scenario	App. Date[B]	Single App. Rate (lbs a.i./A)	# App. per Year	App. Interval (days)	App Method	Application Efficiency/ Spray Drift Fraction
Almond aerial	Almond	CAalmond_WirrigSTD	+30	0.109	4	7	Above crop	Aerial, 0.95/0.125
Corn aerial	Corn	MScornSTD	+30	0.082	6	7	Above crop	Aerial, 0.95/0.125
		NCcornSTD						
		ILcornSTD						
		OHcornSTD						
		PAcornSTD						
		MNcornSTD						
		NEcornSTD						
		KScornSTD						
		IAcornSTD						
		INcornSTD						
Corn ground*	Corn	KScornSTD	-14	0.00498	NS	NS	Δ, Linearly increasing with depth	Ground, 1/0
Cotton aerial	Cotton	MScottonSTD	+30	0.082	3	7	Above crop	Aerial, 0.95/0.125
		CAcotton_wirringSTD						
		NCcottonSTD						
Pecan aerial	Pecan	GApecansSTD	+30	0.109	4	7	Above crop	Aerial, 0.95/0.125
Peanut aerial	Peanut	NCpeanutSTD	+30	0.125	4	14	Above crop	Aerial, 0.95/0.125
Soybean aerial	Soybean	MSsoybeanSTD	+30	0.0563	2	10	Above crop	Aerial, 0.95/0.125
Ornamentals ground	Ornamentals (Residential)	FLnurserySTD_V2	+30	0.272	8[C]	14	Above crop	Ground, 0.99/0.062
		NJnurserySD_V2						
		ORnurserySTD_V2						
		TNnurserySTD_V2						

Run Name [A]	Use Site	PWC Scenario	App. Date[B]	Single App. Rate (lbs a.i./A)	# App. per Year	App. Interval (days)	App Method	Application Efficiency/ Spray Drift Fraction
PA Turf ground	Turf	NJnurserySD_V2	+30	0.6	4[C]	14	Above crop	Ground, 0.99/0.062
FL Turf ground		ORnurserySTD_V2						
Wheat aerial	Wheat	TNnurserySTD_V2	+30	0.0996	2	6	Above crop	Aerial, 0.95/0.125

[A] The selected run name in this table corresponds to the run name in **Table 8-3**.

[B] Label specifies post-emergence application. Therefore, relative to emergence date from respective crop scenario to represent post-emergence for each scenario.

[C] Label does not specify the maximum single applications allowed per cycle year, so it is assumed 8 single applications are allowed per cycle for ornamentals and 4 single applications per year for turf, with three at 0.6 lbs a.i./A and one at 0.2 lbs a.i/A to model the maximum annual application rate of 2.0 lbs a.i./A

*(single rate 0.00498 lb a.i./A) (or 0.00015 lb a.i./lb seeds x 33.2 lb seeds/A); The KS Corn scenario was selected to generate representative EECs for corn seed treatment

Table 8-3 summarizes the metconazole surface water EECs for agricultural and non-agricultural uses. For acute exposure, the 1-in-10-year water column daily average EECs range between 15.5 – 239 µg ai/L. The benthic sediment pore water 1-in-10-year daily average EECs range between 15.2 – 235 µg ai/L. The organic carbon-normalized bulk benthic sediment 1-in-10-year daily EECs range between 23,598 – 364,838 µg ai/kg, with 1-in-10-year 21-day EECs ranging between 15.3 – 238 µg ai/kg. Example PWC inputs and outputs are in **Appendix C**.

Table 8-3. Summary of Surface Water Estimated Environmental Concentrations (EECs) for Metconazole Using PWC version 1.52

Run Name [1]	Use Sites	PWC Scenario	Annual App Rate (lbs a.i./A) App type[1]	1-in-10 Year Mean EEC						
				Water Column (µg/L)			Pore Water (µg/L)		Bulk Sediment (µg/kg-oc) [2]	
				1-day	21-day	60-day	1-day	21-day	1-day	21-day
Almond aerial	Almond	CAalmond_WirrigSTD	0.438, A	30.1	29.6	29.3	28.9	28.9	44875	44875
Corn aerial	Corn	MScornSTD	0.352, A	68.5	68.2	68.0	67.8	67.7	105260	105104
		NCcornSTD		48.3	48.2	48.0	47.9	47.8	74365	74210
		ILcornSTD		58.8	58.6	58.4	58.3	58.3	90511	90511
		OHcornSTD		48.3	48.0	47.8	47.6	47.6	73899	73899
		PAcornSTD		49.4	49.2	49.1	49.0	49.0	76073	76073

Run Name [1]	Use Sites	PWC Scenario	Annual App Rate (lbs a.i./A) App type[1]	1-in-10 Year Mean EEC						
				Water Column (µg/L)			Pore Water (µg/L)		Bulk Sediment (µg/kg-oc) [2]	
				1-day	21-day	60-day	1-day	21-day	1-day	21-day
		MNcornSTD		47.3	47.0	46.9	46.7	46.9	72502	72812
		NEcornSTD		67.0	66.6	66.3	66.1	66.1	102620	102620
		KScornSTD		71.3	71.1	70.8	70.3	70.3	109141	109141
		lAcornSTD		43.3	42.4	41.8	41.5	41.5	64429	64429
		INcornSTD		52.4	51.7	51.1	50.7	50.7	78712	78712
Corn ground	Corn	KScornSTD	0.00498, G	0.229	0.228	0.227	0.225	0.225	349.3	349.3
	Cotton	MScottonSTD		39.8	39.2	39.1	38.9	38.9	60392	60392
		CAcotton_wirringSTD	0.246, A	19.5	19.2	19.0	18.6	18.6	28877	28877
Cotton aerial		NCcottonSTD		50.6	50.4	50.2	50.0	50.0	77625	77625
Pecan aerial	Pecan	GApecansSTD	0.438, A	53.7	53.0	52.0	52.0	52.0	80730	80730
Peanuts aerial	Peanut	NCpeanutSTD	0.5, A	59.1	58.8	58.6	58.3	58.3	90976	90976
Soybean aerial	Soybean	MSsoybeanSTD	0.113, A	15.5	15.3	15.3	15.2	15.2	23598	23598
	Ornamentals	**FLnurserySTD_V2**		**239.0**	**238.0**	**237.0**	**235.0**	**235.0**	**364838**	**364838**
		NJnurserySD_V2	2.0, G	174.0	173.0	173.0	172.0	172.0	267030	267030
Ornamentals		ORnurserySTD_V2		101.0	101.0	100.0	100.0	100.0	155250	155250
ground		TNnurserySTD_V2		175.0	174.0	173.0	172.0	172.0	267030	267030
Turf ground	Turf	PAturfSTD	2.0, G	93.3	92.6	92.0	91.3	91.3	141743	141743
		FLturfSTD		72.1	71.4	70.8	69.9	69.9	108520	108520
Wheat aerial	Wheat	NDwheatSTD	0.199, A	22.3	21.9	21.8	21.7	21.7	33689	33689

[1]Application types: A – Aerial spray, G – ground boom spray.

[2] The reported are based on organic carbon (OC)-normalized values (*i.e.*, the bulk sediment EECs with a benthic conversion of 62.1 are divided by 0.04 to account for the 4% carbon content of the soil used in the modeling).

8.1.2 Monitoring

Monitoring data were queried for metconazole on April 28, 2020 from the Water Quality Portal (WQP) website (http://waterqualitydata.us/[2]), which integrates public available water quality data from the USGS National Water Information System (NWIS), the EPA STOrage and RETrieval (STORET) Data Warehouse, and the USDA ARS Sustaining The Earth's Watersheds Agricultural Research Database System (STEWARDS)**.** A total of 16,843 of surface and ground water routine samples were collected from 2007- 2020 for metconazole. A total of 14,140 samples were collected for surface water and metconazole was not detected in any sample. A total of 2,703 samples were collected for ground water and metconazole was not detected in any samples. In summary, the dataset for metconazole indicated 0 % detection in surface water and ground water samples with a method detection limit of 5.2 ng/L.

Monitoring data for surface water and ground water from the California Department of Pesticide Regulation (CDPR)[3] were also searched on April 28, 2020. There were 1,083 surface water samples and metconazole was not detected at or above the maximum level of quantification (0.0115 µg/L) and there were no detections reported for metconazole from ground water monitoring data available from CDPR.

The USDA-Pesticide Monitoring Data (PDP)[4] were also searched on April 28, 2020 for monitoring data of finished water samples from surface water and ground water sources. Metconazole was not detected in finished water.

Metconazole was not detected in any non-targeted monitoring data queried. It should be noted that the no detections with a limit of quantification reported as the method detection limit of 5.2 ng/L for metconazole would not likely correspond to the modeled 1-day mean concentrations, particularly because metconazole is stable in aquatic environments and a 30 year mean concentration would be a better predictor for comparing modeled and monitored concentrations in water.

8.2 Aquatic Organism Risk Characterization

Surface water, pore water, and sediment concentrations from metconazole uses were estimated based on spray drift, runoff, and erosion contributions. The most sensitive toxicity endpoints were used to derive risk quotients (RQs) (**Table 6-1**). The 1-in-10-year 1-day mean EECs are compared to acute toxicity endpoints (LC_{50} values) to derive acute RQs for both aquatic vertebrates (Fish and aquatic phase amphibians) and invertebrates. The 1-in-10-year 21-day

[2] https://www.waterqualitydata.us/

[3] http://www.cdpr.ca.gov/docs/emon/ehap.htm

[4] https://apps.ams.usda.gov/PDP

mean EECs are compared to chronic toxicity endpoints (NOAEC values) to derive chronic RQs for aquatic invertebrates and the 1-in-10-year 60-day mean EECs are compared to toxicity endpoints (NOAECs) to derive chronic RQs for aquatic vertebrates. For aquatic RQs, the EECs listed in **Table 8-3** were compared to the relevant toxicity endpoints to generate the aquatic RQs in **Tables 8-4 to 8-6**. The highest exposures by crop group were selected, across application scenarios and methods (A – Aerial spray, and G – Ground spray).

8.2.1 Aquatic Vertebrates (Fish and Aquatic -Phase Amphibians)

Table 8-4 provides acute and chronic RQs for freshwater and saltwater fish exposed to metconazole. There are no acute LOC (0.5) exceedances for both freshwater and saltwater fish for modeled application scenarios by PWC. However, RQs for chronic exposure exceeded the chronic LOC (1) for freshwater (RQ ranges 5.3 – 82) and estuarine/marine water fish (RQ ranges 1. – 22). The highest chronic EECs (237 µg a.i./L) are about 26 time higher than the chronic LOAEC (9 µg a.i./L) based on 14% reduction of fry survival for freshwater fish and about 10 times higher than the chronic LOAEC (24 µg a.i./L) based on reduced 9% dry weight and 3% length for saltwater fish. Additionally, since metconazole is persistent, it accumulates in pond water over time. For example, the highest chronic EECs are 11.2, 39.6, 95.1, 184 and 237 µg a.i./L for year 1, 5, 10, 20 and 30, respectively based on the FL nursery scenario. The first year EECs (11.2 µg a.i./L) exceed the LOAEC values for freshwater fish (9 µg a.i./L) and saltwater fish (11 µg a.i./L), suggesting that risk to the taxa will only increase after each use. There was no risk concern identified for freshwater and saltwater fish (aquatic phase amphibians) from metconazole use as seed treatments.

Table 8-4 Risk Quotients (RQs) for Freshwater and Estuarine/Marine Fish Exposed to Metconazole

Application Scenario / Methods[1]	1-in-10 Yr EEC (µg a.i./L)		Risk Quotient			
			Freshwater		Estuarine/Marine	
			Acute	Chronic	Acute	Chronic
	Daily Ave	60-day Ave	LC_{50} (µg a.i./L)	NOAEC (µg a.i./L)	LC_{50} (µg a.i./L)	NOAEC (µg a.i./L)
			3300	**2.90**	**6300**	**11.0**
CAalmond_WirrigSTD.scn /A	30.1	29.3	0.01	**10.10**	<0.01	**2.66**
MScornSTD.scn /A	68.5	68	0.02	**23.45**	0.01	**6.18**
NCcornSTD.scn /A	48.3	48	0.01	**16.55**	0.01	**4.36**
ILcornSTD.scn /A	58.8	58.4	0.02	**20.14**	0.01	**5.31**
OHcornSTD.scn /A	48.3	47.8	0.01	**16.48**	0.01	**4.35**
PAcornSTD.scn /A	49.4	49.1	0.01	**16.93**	0.01	**4.46**
MNcornSTD.scn /A	47.3	46.9	0.01	**16.17**	0.01	**4.26**
NEcornSTD.scn /A	67	66.3	0.02	**22.86**	0.01	**6.03**
KScornSTD.scn /A	71.3	70.8	0.02	**24.41**	0.01	**6.44**
IAcornSTD.scn /A	43.3	41.8	0.01	**14.41**	0.01	**3.80**

INcornSTD.scn /A	52.4	51.1	0.02	**17.62**	0.01	**4.65**
MScottonSTD.scn /A	39.8	39.1	0.01	**13.48**	0.01	**3.55**
CAcotton_wirringSTD.scn /A	19.5	19	0.01	**6.55**	<0.01	**1.73**
NCcottonSTD.scn /A	50.6	50.2	0.02	**17.31**	0.01	**4.56**
GApecansSTD.scn /A	53.7	52	0.02	**17.93**	0.01	**4.73**
NCpeanutSTD.scn /A	59.1	58.6	0.02	**20.21**	0.01	**5.33**
MSsoybeanSTD.scn /A	15.5	15.3	0.00	**5.28**	<0.01	**1.39**
FLnurserySTD_V2.scn /G	239	237	0.07	**81.72**	0.04	**21.55**
NJnurserySD_V2.scn /G	174	173	0.05	**59.66**	0.03	**15.73**
ORnurserySTD_V2.scn /G	101	100	0.03	**34.48**	0.02	**9.09**
TNnurserySTD_V2.scn /G	175	173	0.05	**59.66**	0.03	**15.73**
PAturfSTD.scn /G	93.3	92	0.03	**31.72**	0.01	**8.36**
FLturfSTD.scn /G	72.1	70.8	0.02	**24.41**	0.01	**6.44**
NDwheatSTD.scn /A	22.3	21.8	0.01	**7.52**	<0.01	**1.98**
KScornSTD.scn/Seed	0.229	0.227	<0.01	0.08	<0.01	0.02

[1] Application methods: A – aerial, G – ground, Seed – seed treatment

Bolded font indicted RQ exceeds LOC (1)

8.2.2 Aquatic Invertebrates

Table 8-4 provides acute and chronic RQs for freshwater and saltwater invertebrates exposed to metconazole. There were no LOC (0.5) exceedances for acute exposure. Chronic LOC values for freshwater (RQ ranges 0.49 – 7.68) and estuarine/marine invertebrates (RQ ranges 0.26 – 4.03) were exceeded. The highest chronic EECs (238 µg a.i./L) are about 2x higher than the chronic LOAEC (120 µg a.i./L) based on 24% reduction of young adult survival for freshwater invertebrates. Therefore, there is risk concern for freshwater invertebrates exposed to metconazole on a chronic basis. However, the chronic LOAEC (>59 µg a.i./L) for saltwater invertebrates is non-definitive without observed chronic effects. Therefore, chronic exposure risk to saltwater invertebrates is considered low. There was no risk concern identified for aquatic invertebrates from metconazole use as seed treatment.

Table 8-5. Acute and Chronic Risk Quotients (RQs) for Freshwater and Estuarine/Marine Invertebrates Exposed to Metconazole

Application Scenarios / Methods[1]	1-in-10 Yr EEC (µg a.i./L)		Risk Quotient			
			Freshwater		Estuarine/Marine	
			Acute	Chronic	Acute	Chronic
	Daily Ave	21-day Ave	LC_{50} (µg a.i./L)	NOAEC (µg a.i./L)	LC_{50} (µg a.i./L)	NOAEC (µg a.i./L)
			5900	**31**	**780**	**59**
CAalmond_WirrigSTD.scn /A	30.1	29.6	<0.01	0.95	<0.01	0.50
MScornSTD.scn /A	68.5	68.2	<0.01	**2.20**	*0.1*	**1.16**
NCcornSTD.scn /A	48.3	48.2	<0.01	**1.55**	*0.1*	0.82
ILcornSTD.scn /A	58.8	58.6	<0.01	**1.89**	*0.1*	0.99

OHcornSTD.scn /A	48.3	48	<0.01	**1.55**	*0.1*	0.81
PAcornSTD.scn /A	49.4	49.2	<0.01	**1.59**	*0.1*	0.83
MNcornSTD.scn /A	47.3	47	<0.01	**1.52**	*0.1*	0.80
NEcornSTD.scn /A	67	66.6	<0.01	**2.15**	*0.1*	**1.13**
KScornSTD.scn /A	71.3	71.1	<0.01	**2.29**	*0.1*	**1.21**
IAcornSTD.scn /A	43.3	42.4	<0.01	**1.37**	*0.1*	0.72
INcornSTD.scn /A	52.4	51.7	<0.01	**1.67**	*0.1*	0.88
MScottonSTD.scn /A	39.8	39.2	<0.01	**1.26**	*0.1*	0.66
CAcotton_wirringSTD.scn /A	19.5	19.2	<0.01	0.62	<0.01	0.33
NCcottonSTD.scn /A	50.6	50.4	<0.01	**1.63**	*0.1*	0.85
GApecansSTD.scn /A	53.7	53	<0.01	**1.71**	*0.1*	0.90
NCpeanutSTD.scn /A	59.1	58.8	<0.01	**1.90**	*0.1*	1.00
MSsoybeanSTD.scn /A	15.5	15.3	<0.01	0.49	<0.01	0.26
FLnurserySTD_V2.scn /G	239	238	<0.01	**7.68**	*0.3*	**4.03**
NJnurserySD_V2.scn /G	174	173	<0.01	**5.58**	*0.2*	**2.93**
ORnurserySTD_V2.scn /G	101	101	<0.01	**3.26**	*0.1*	**1.71**
TNnurserySTD_V2.scn /G	175	174	<0.01	**5.61**	*0.2*	**2.95**
PAturfSTD.scn /G	93.3	92.6	<0.01	**2.99**	*0.1*	**1.57**
FLturfSTD.scn /G	72.1	71.4	<0.01	**2.30**	*0.1*	**1.21**
NDwheatSTD.scn /A	22.3	21.9	<0.01	0.71	<0.01	0.37
KScornSTD.scn/Seed	0.229	0.228	<0.01	0.01	<0.01	<0.01

[1] Application methods: A – aerial, G – ground, Seed – seed treatment

Bolded font indicted RQ exceeds LOC (1)

8.2.3 Aquatic Benthic Invertebrates

The only sediment invertebrate toxicity study that is suitable for generating risk quotients is for the saltwater amphipod (*Leptocheirus plumulosus*; MRID 50674401). The NOAEC (5730 µg/L-pore water) from this study is used to calculate RQs for saltwater and freshwater benthic invertebrates. All RQs (up to 0.04) are two orders of magnitude below the LOC (1.0). There are two supplemental toxicity studies available for freshwater benthic invertebrates exposed to metconazole. One is for freshwater amphipod (*Hyalella azteca*) with LOAEC (3100 µg/L-pore water) (MRID 48937401) and another is for freshwater midge (*Chironomus riparius)* with LOAEC (535 µg/L-pore water) (MRID 47795006). The endpoints from these studies are uncertain because a clear dose-response pattern was not observed in the effect endpoints (i.e., significant effects were not observed at higher test levels than the LOAEC). If the EECs (up to 235 µg/L) were compared to the LOAEC values from these two supplemental studies, they would not exceed those values. Therefore, considering the RQs and the supplemental data, we conclude that potential chronic risk to benthic invertebrates from exposure to metconazole is considered low.

8.2.4 Aquatic Plants

RQs were calculated for vascular and non-vascular plant exposures to metconazole (**Table 8-6**). The most sensitive IC_{50} for vascular plants is 22 µg a.i./L and for non-vascalar plants is 81 µg a.i./L. Risk concerns were identified for metconazole exposure to vascular plants (RQ ranges 0.7 – 10.9) for all agricultural and non-agricultural use patterns. For non-vascular plants, RQs ranged from 0.19 – 2.95 and risk concerns were identified only for non-agricultural ornamental and turf uses. Risk concern is low to aquatic plants for seed treatments (RQ < 0.01).

Table 8-6. Risk Quotients of Aquatic Plants

Application Scenarios / Methods[1]	1-in-10 Year Daily Average EEC µg/L	Risk Quotients	
		Vascular	Non-vascular
		IC_{50} (µg a.i./L)	IC_{50} (µg a.i./L)
		22	81
CAalmond_WirrigSTD.scn /A	30.1	**1.37**	0.37
MScornSTD.scn /A	68.5	**3.11**	0.85
NCcornSTD.scn /A	48.3	**2.20**	0.60
ILcornSTD.scn /A	58.8	**2.67**	0.73
OHcornSTD.scn /A	48.3	**2.20**	0.60
PAcornSTD.scn /A	49.4	**2.25**	0.61
MNcornSTD.scn /A	47.3	**2.15**	0.58
NEcornSTD.scn /A	67	**3.05**	0.83
KScornSTD.scn /A	71.3	**3.24**	0.88
IAcornSTD.scn /A	43.3	**1.97**	0.53
INcornSTD.scn /A	52.4	**2.38**	0.65
MScottonSTD.scn /A	39.8	**1.81**	0.49
CAcotton_wirringSTD.scn /A	19.5	**0.89**	0.24
NCcottonSTD.scn /A	50.6	**2.30**	0.62
GApecansSTD.scn /A	53.7	**2.44**	0.66
NCpeanutSTD.scn /A	59.1	**2.69**	0.73
MSsoybeanSTD.scn /A	15.5	0.70	0.19
FLnurserySTD_V2.scn /G	239	**10.86**	**2.95**
NJnurserySD_V2.scn /G	174	**7.91**	**2.15**
ORnurserySTD_V2.scn /G	101	**4.59**	**1.25**
TNnurserySTD_V2.scn /G	175	**7.95**	**2.16**
PAturfSTD.scn /G	93.3	**4.24**	**1.15**
FLturfSTD.scn /G	72.1	**3.28**	0.89
NDwheatSTD.scn /A	22.3	**1.01**	0.28
KScornSTD.scn/Seed	0.229	0.01	0.45

[1] Application methods: A – aerial, G – ground, Seed – seed treatment

Bolded font indicted RQ exceeds LOC (1)

9. TERRESTRIAL VERTEBRATES RISK ASSESSMENT

9.1 Terrestrial Vertebrate Exposure Assessment

Terrestrial vertebrate exposure estimates are calculated for birds and mammals by emphasizing the dietary exposure route of uptake of pesticide active ingredients. Birds are surrogates for terrestrial-phase amphibians and reptiles. For exposures to terrestrial organisms, such as birds and mammals, pesticide residues on food items are estimated based on the assumption that organisms are exposed to pesticide residues as a function of the pesticide use pattern. Metconazole is applied through aerial and ground spray. Therefore, potential dietary exposure for terrestrial vertebrates in this assessment is based on consumption of metconazole residues on food items following the maximum annual application rate for aerial and ground application on foliar. EECs for birds[5] and mammals from consumption of dietary items on the treated fields were calculated using T-REX v.1.5.2 (**Table 9-1**). An example of T-REX output for metconazole is available in **Appendix D**.

Terrestrial wildlife may also be exposed through ingestion of residues accumulated in aquatic organisms that serve as prey. A log Kow of 3.85 suggests that metconazole has the potential for bioaccumulation. Exposure through this pathway is evaluated using KABAM.

9.1.1 Dietary Items on the Treated Field

T-REX (v. 1.5.2) is used to calculate dietary- and dose-based EECs of metconazole residues on food items for mammals and birds generated for the labeled spray uses. Upper-bound Kenaga nomogram values are used to derive EECs for metconazole exposures to terrestrial mammals and birds, based on a 1-year period. Mean Kenaga values (when presented) are used for additional characterization. Consideration is given to different types of feeding strategies for mammals, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1000 g) and three weight classes of mammals (15 g, 35 g, and 1000 g). Several representative application scenarios which represent the highest application rate for agricultural, non-agricultural uses as well as the seed treatment were chosen for turf annual rate at 2 lb a.i./A (single rate at 0.6 lb a.i./acre for 4 applications at 14-day interval), tuberous and corm vegetables at annual rate 0.5 lb a.i./A (single rate 0.125 lb a.i./acre for 4 applications at 7-day interval by aerial spray), turf single rate at 0.6 lb a.i./acre, tuberous and corm vegetables at single rate 0.125 lb a.i./acre and corn seed treatment at 0.00498 lb a.i./A (**Table 9-1).**

[5] Birds are also used as a proxy for reptiles and terrestrial-phase amphibians.

The 35-day default foliar half-life was used for RQ calculation. The default foliar half-life is based on the high-end range of empirical data presented in a meta-data analysis by Willis and McDowell (1987) as data were not located to derive a metconazole-specific foliar dissipation half-life. This has relevance to risk characterization for metconazole because the fungicide is applied multiple times annually. The half-life influences the magnitude of the EEC over time and may influence the peak EEC used to derive RQs when there are multiple applications. It should be noted that the default value does not impact the peak EEC for single applications. Therefore, using the default 35-day half-life does not impact the conclusions when the LOC is exceeded for a single application. The use of the default foliar dissipation half-life is not considered a major uncertainty in this assessment, as it is supported by other fate data for metconazole that have half-lives on the order of months (i.e., soil metabolism and terrestrial dissipation half-lives).

Table 9-1. Summary of Dietary (mg a.i./kg-diet) and Dose-based Estimated Environmental Concentrations (EECs in mg a.i./kg-bw) as Food Residues for Birds (Reptiles, Terrestrial-Phase Amphibians) and Mammals from Labeled Uses of Metconazole (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Dietary-Based EEC (mg/kg-diet)	Dose-Based EEC (mg/kg-body weight)					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray)							
Short grass	336	383	218	98	320	221	51
Tall grass	154	175	100	45	147	101	24
Broadleaf plants/small insects	189	215	123	55	180	124	29
Fruits/pods	21	24	14	6.1	20	14	3.2
Arthropods	131	150	85	38	125	87	20
Seeds (granivore)[1]	21	5.3	3.0	1.4	4.5	3.1	0.71
Turf (single rate 0.6 lb a.i./acre by ground boom sprayer)							
Short grass	144	164	94	42	137	95	22
Tall grass	66	75	43	19	63	43	10
Broadleaf plants/small insects	81	92	53	24	77	53	12
Fruits/pods	9	10	5.9	2.6	8.6	5.9	1.4
Arthropods	56	64	37	16	54	37	8.6
Seeds (granivore)[1]	9	2.3	1.3	0.58	1.9	1.3	0.31
Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre, 7-day interval and annual rate 0.5 lb a.i./A by aerial spray)							
Short grass	99	112	64	29	94	65	15
Tall grass	45	51	29	13	43	30	6.9

Food Type	Dietary-Based EEC (mg/kg-diet)	Dose-Based EEC (mg/kg-body weight)					
		Birds			Mammals		
		Small (20 g)	Medium (100 g)	Large (1000 g)	Small (15 g)	Medium (35 g)	Large (1000 g)
Broadleaf plants/small insects	55	63	36	16	53	37	8.5
Fruits/pods	6.2	7.0	4.0	1.8	5.9	4.1	0.9
Arthropods	39	44	25	11	37	25	5.9
Seeds (granivore)[1]	6.2	1.6	0.9	0.4	1.3	0.9	0.2
Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre by aerial spray)							
Short grass	30	34	19	8.7	29	20	4.6
Tall grass	14	16	8.9	4.0	13	9.1	2.1
Broadleaf plants/small insects	17	19	11	4.9	16	11	2.6
Fruits/pods	1.9	2.1	1.2	0.6	1.8	1.2	0.3
Arthropods	12	13	7.6	3.4	11	7.7	1.8
Seeds (granivore)[1]	1.9	0.47	0.27	0.12	0.4	0.27	0.06
Corn seed treatment (single rate 0.00015 lb a.i./lb seed x 33.2 lbs/A seeding rate = 0.00498 lb a.i./A)							
	Maximum Seed Appliaction Rate (mg a.i./Kg seed)	**Avian Nagy dose (mg ai/kg-bw/day)**			**Avian Nagy dose (mg ai/kg-bw/day)**		
Corn Seeds	3.24	0.82	0.47	0.21	0.69	0.47	0.11

[1] Seeds presented separately for dose – based EECs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

9.1.2 Spray Drift

Spray drift modeling considered off-field risk to birds and mammals exposed to metconazole spray applications. The footprint of off-field spray drift from the agricultural field was investigated for birds and mammals following the *Environmental Fate and Effects Division Offsite Transport Guidance* (USEPA, 2013c). The AgDRIFT™ model (v. 2.1.1) and the RQs generated with TREX were used to estimate the potential distances that would result in RQ values what exceed the acute and chronic risk LOCs for birds and mammals as a result of spray drift deposition off-field. The fraction of applied metconazole for terrestrial animals was calculated using RQ from T-REX that reflect the modeling completed for the on-field risk quantification discussed above. The EECs for the two top application rates on turf and tuberous/corm vegetables exceeding the LOC were chosen to estimate the off-field distance for chronic risk to mammals and birds. Modeling for ground application was conducted based on EFED default input parameters using low boom and find to very fine droplets. For aerial application, fine to medium drop size distribution was assumed. Single applications are considered for aerial and ground application.

9.1.3 K_{OW} (based) Aquatic Bioaccumulation Model

Terrestrial wildlife may also be exposed through ingestion of residues in aquatic organisms that serve as prey. Metconazole has a log K_{ow} of 3.85, which suggests its potential for bioaccumulation. KABAM was used to evaluate the potential exposure and likelihood of direct adverse effects to birds and mammals via consumption of prey in which bioaccumulation and biomagnification of residues has occurred through the aquatic food webs. The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on polychlorinated biphenyls (PCBs) and some pesticides (*e.g.*, lindane, DDT) in freshwater aquatic ecosystems (Arnot and Gobas, 2004). KABAM relies on a chemical's K_{OW} to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for organisms at different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose and dietary-based exposures and associated risks to mammals and birds (reptiles and terrestrial-phase amphibians) consuming aquatic organisms. Seven different trophic levels including phytoplankton, zooplankton, benthic invertebrates, filter feeders, small-sized (juvenile) forage fish, medium-sized forage fish, and larger piscivorous fish, are used to represent an aquatic food web.

Metconazole bioaccumulation potential is analyzed by KABAM model. **Table 9-2** lists the KABAM input parameters and **Table 9-6** summarizes the results. See **Appendix E** for KABAM output values.

Table 9-2. Bioaccumulation Model (KABAM) Chemical Input Values for Metconazole

Characteristic	Value	Comments/Guidance
Pesticide Name	**Metconazole**	**Required input**
Log K_{OW}	**3.85**	**Required input** Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**7079**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**1544**	**Required input** Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**4**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.

Pore water EEC (µg/L)	**235**	**Required input** Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**238**	**Required input** Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

9.2 Terrestrial Vertebrate Risk Characterization

9.2.1 Birds

Acute

Dose-based acute RQs were calculated for the highest annual rate at 2 lb a.i./A on non-agricultural uses turf and ornamentals and 0.5 lb a.i./A for agricultural uses tuberous and corm vegetables. For non-agricultural uses, LOC thresholds (0.5) are exceeded for small bird (20 g) feeding on short grasses (RQ = 0.68) based on upper bound Kenaga. However, no exceedance was noted when mean Kenaga values were used (**Table 9-3**). No RQs are exceeded for agricultural uses. RQs for acute dietary exposure exceeded LOC (0.5) for 16 days, using the upper bound Kenaga values across all weight cases except for birds feeding on fruits/pod/seeds for the maximum annual application (2 lb a.i./A) on turf and ornamentals (**Table 9-3**). However, the acute LOC (0.5) is not exceeded when using mean Kenaga values. The acute risk concern for birds exposed to metconazole treated seeds is low because less application rate (**Table 9-3**).

Table 9-3. Acute RQ values for Birds from Labeled Max Uses of Metconazole (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 777 mg a.i./kg-bw			Acute Dietary-Based RQ LD_{50} = 249 mg a.i./kg-bw	
	Small (15 g)	Medium (35 g)	Large (1000 g)	Upper Kenaga	Mean Kenaga
Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray) -Represent the highest annual rate for non-agricultural uses					
Short grass	**0.68**	0.31	0.10	**1.35**	0.48
Tall grass	0.31	0.14	0.04	**0.62**	0.20
Broadleaf plants	0.38	0.17	0.05	**0.76**	0.25
Fruits/pods	0.04	0.02	0.01	0.08	0.04
Arthropods	0.27	0.12	0.04	**0.53**	0.37
Seeds[1]	0.01	<0.01	<0.01	0.08	0.04
Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre, 7-day interval and annual rate 0.5 lb a.i./A by aerial spray) -Represent the highest annual rate for agricultural uses					
Short grass	0.20	0.09	0.03	0.40	0.14
Tall grass	0.09	0.04	0.01	0.18	0.06
Broadleaf plants	0.11	0.05	0.02	0.22	0.07
Fruits/pods	0.01	0.01	<0.01	0.02	0.01
Arthropods	0.08	0.04	0.01	0.16	0.11
Seeds[1]	<0.01	<0.01	<0.01	0.40	0.14
Corn seed treatment (single rate 0.00498 lb a.i./A) (or 0.00015 lb a.i./lb seeds x 33.2 lb seeds/A)					
Corn Seeds[1]	<0.01	<0.01	<0.01	NA	NA

[1] Seeds presented separately for dose based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

Chronic

Chronic RQs exceed the LOC (1) for all weight classes except for birds feeding on fruits/pod/seeds at the maximum annual rate at 2 lb a.i./A, and for birds feeding on fruits/pod/seeds and arthropods at the maximum single rate at 0.6 lb a.i./A for turf and ornamentals based on the upper bound Kenaga values. Evaluating based on the mean Kenaga values indicate that the chronic RQs exceed the LOC for birds feeding on shortgrass, broadleaf plants and arthropods at the maximum annual rate of 2 lb a.i./A but no exceedance at 0.6 lb a.i./A (**Table 9-4**). Most of dietary based chronic EECs (**Table 9-1**) exceed the LOAEC (114 mg/kg-diet) based on 43% reduction in hatching eggs and 49% reduction in hatching survival chick (**Table 6-2**). For turf uses, about 125 days' EECs exceed the NOAEC (58 mg ai/kg-diet) and 91 days' EECs exceed the LOAEC (114 mg/kg-diet) for birds. For the highest agricultural uses on tuberous and corm vegetables, the chronic RQs for birds do not exceed the LOC (1) except for birds feeding on short grass at the maximum annual rate of 1.25 lb a.i./A and there are no LOC exceedance for the maximum single rate at 0.6 lb a.i./A based the upper bound Kenaga values. The maximum dietary EECs of chronic based is 99 mg/kg-diet which do not exceed the LOAEC (114 mg/kg-diet) (**Table 6-2**). In summary, there are chronic risk concerns for birds exposed to metconazole, especially for non-agricultural uses, but low risk concerns for birds exposed to metconazole treated seeds (**Table 9-4**).

Table 9-4. Chronic Risk Quotient (RQ) values for Birds (Reptiles, and Terrestrial-Phase Amphibians) from Labeled Uses of Metconazole (T-REX v. 1.5.2, Upper and Mean Kenaga)

Food Type	Chronic Dietary RQ (NOAEC = 58 mg a.i./kg-diet)	
	Upper Bound Kenaga	Mean Kenaga
Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray) -Represent the highest annual rate for non-agricultural uses		
Short grass	**5.8**	**2.1**
Tall grass	**2.7**	0.87
Broadleaf plants	**3.3**	**1.1**
Fruits/pod/seeds	0.36	0.17
Arthropods	**2.3**	**1.6**
Turf (single rate 0.6 lb a.i./acre by ground spray) -Represent the highest single rate for non-agricultural uses		
Short grass	**2.5**	0.88
Tall grass	**1.1**	0.37
Broadleaf plants	**1.4**	0.47
Fruits/pod/seeds	0.16	0.07
Arthropods	0.97	0.67
Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre, 7-day interval and annual rate 0.5 lb a.i./A by aerial spray) -Represent the highest annual rate for agricultural uses		
Short grass	**1.7**	0.60
Tall grass	0.78	0.26
Broadleaf plants	0.96	0.32
Fruits/pod/seeds	0.11	0.05
Arthropods	0.67	0.46
Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre by aerial spray) -Represent the highest single rate for agricultural uses		
Short grass	0.52	0.18
Tall grass	0.24	0.08
Broadleaf plants	0.29	0.10
Fruits/pod/seeds	0.03	0.02
Arthropods	0.20	0.14
Corn seed treatment (single rate 0.00498 lb a.i./A) (or 0.00015 lb a.i./lb seeds x 33.2 lb seeds/A)		
Corn seeds	0.06	N/A

Bolded values exceed the level of concern (LOC) of the chronic risk LOC of 1.0.

Spray Drift Risk

As described in **Section 9.1.3**, AgDRIFT™ (version 2.1.1) was used to model the drift distance to the LOC (*i.e.,* the distance extending from the edge of the field out to where the RQ exceeds the LOC). When modeling multiple spray drift events, the assumption is that the wind is blowing at the same speed and in the same direction. Spray drift resulting from multiple applications may increase the probability of offsite dietary exposure to birds. This analysis suggests that the chronic risk LOC for birds is exceeded up to 7 feet and 3 feet from the use site for multiple and single ground applications, respectively (**Table 9-5).**

Table 9-5. Spray drift distances offset to reduce the chronic risk to birds

Crops	Highest Exceeding RQ	App Rate (lbs a.i./A)	Aerial (feet)	Ground (feet)
Multiple applications on non-agricultural turf and agricultural tuberous and corm vegetables				
Non-Agricultural turf	5.8	2 (max annual rate)	NA	7
Agricultural vegetables	1.7	0.5 (max annual rate)	0	3
Single applications on non-agricultural turf and agricultural tuberous and corm vegetables				
Non-Agricultural turf	2.5	0.6 (max single rate)	NA	3
Agricultural vegetables	0.52	0.125 (max single rate)	0	0

NA: Not applicable because metconazole is only applied to using ground equipment.

9.2.2 Mammals

Acute

Dose-based acute RQs (0.01 - 0.49) are calculated for mammals based on an acute oral toxicity endpoint (LD_{50} = 595 mg a.i./kg-bw) for mice with a 22-g body size. No LOC (0.5) was exceeded for the highest annual application rate at 2 lb a.i./A **(Table 9-6)**. Consequently, the acute risk concern is not expected for mammals exposed to the metconazole uses for all application patterns.

Table 9-6. Acute RQ values for Mammals from Labeled Max Uses of Metconazole (T-REX v. 1.5.2, Upper Bound Kenaga)

Food Type	Acute Dose-Based RQ LD_{50} = 595 mg a.i./kg-bw		
	Small (15 g)	Medium (35 g)	Large (1000 g)
Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray)			
Short grass	0.49	0.42	0.22
Tall grass	0.22	0.19	0.10
Broadleaf plants	0.28	0.23	0.13
Fruits/pods/seeds	0.03	0.03	0.01
Arthropods	0.19	0.16	0.09
Seeds[1]	0.01	0.01	<0.01

[1] Seeds presented separately for dose based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

Chronic

Chronic RQs exceed the LOC (1) for all weight classes except for mammals feeding on seeds at the maximum annual rate at 2 lb a.i./A, and also exceed the LOC except for mammals feeding on fruits/pods and seeds at the maximum single rate at 0.6 lb a.i./A based the upper bound Kenaga values (**Table 9-7)**. For turf uses, EECs exceeded the NOAEC (150 mg ai/kg-diet) about 63 days,

but do not exceed the LOAEC (750 mg/kg-diet) for mammals. Using the mean Kenaga values, the chronic RQs exceed the LOC for all size mammals feeding on shortgrass, tallgrass, broadleaf plants and arthropods for the maximum annual rate of 2 lb a.i./A and there are similar risk concerns for small and medium size mammals at the maximum single use rate at 0.6 lb a.i./A. However, the maximum chronic dietary EEC (336 mg/kg-diet) (**Table 9-1**) does not exceed the LOAEC (750 mg/kg-diet) based on parental decreased (10-13%) body weight, and weight gain in F1 females (**Table 6-2**).

The highest application rate among the agricultural uses of metconazole is represented by the use on tuberous and corm vegetables with maximum annual rate of 0.5 lb a.i./A, for which the chronic RQs exceed the LOC (1) for all size mammals except those feeding on fruits/pods/seeds and only for small and medium size mammals feeding on short grass at the single rate at 0.125 lb a.i./A based the upper bound Kenaga values. The chronic RQs based on the mean Kenaga values also exceed the LOC for small and medium size mammals feeding on short grass and arthropods for the maximum annual rate. The maximum dietary chronic EEC is 99 mg/kg-diet for tuberous and corm vegetables (**Table 9-1**) which does not exceed the NOAEC (150 mg/Kg-diet) and LOAEC (750 mg/kg-diet) (**Table 6-2**). Nevertheless, there are chronic risk concerns for mammals exposed to metconazole foliar sprays and low risk concerns for mammals exposed to metconazole treated seeds (**Table 9-7**).

Table 9-7. Chronic RQ values for Mammals from Labeled Uses of Metconazole (T-REX v. 1.5.2)

Food Type	Chronic Dose-Based RQ NOAEL = 7.5 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 150 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Upper Kenaga Values --Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray) -Represent the highest annual rate for non-agricultural uses				
Short grass	**19.42**	**16.59**	**8.89**	**2.24**
Tall grass	**8.90**	**7.60**	**4.08**	**1.03**
Broadleaf plants	**10.93**	**9.33**	**5.00**	**1.26**
Fruits/pods	**1.21**	**1.04**	0.56	0.14
Arthropods	**7.61**	**6.50**	**3.48**	0.88
Seeds[1]	0.27	0.23	0.12	0.14
Mean Kenaga Values --Turf (single rate 0.6 lb a.i./acre, 14-day interval and annual rate 2 lb a.i./A by ground spray) -Represent the highest annual rate for non-agricultural uses				
Short grass	**6.88**	**5.88**	**3.15**	0.79
Tall grass	**2.91**	**2.49**	**1.33**	0.34
Broadleaf plants	**3.64**	**3.11**	**1.67**	0.42
Fruits/pods	0.57	0.48	0.26	0.07
Arthropods	**5.26**	**4.49**	**2.41**	0.61
Seeds[1]	0.13	0.11	0.06	0.07
Upper Kenaga Values --Turf (single rate 0.6 lb a.i./acre by ground boom sprayer) -Represent the highest single rate for non-agricultural uses				
Short grass	**8.33**	**7.11**	**3.81**	0.96

Food Type	Chronic Dose-Based RQ NOAEL = 7.5 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 150 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Tall grass	**3.82**	**3.26**	**1.75**	0.44
Broadleaf plants	**4.69**	**4.00**	**2.15**	0.54
Fruits/pods	0.52	0.44	0.24	0.06
Arthropods	**3.26**	**2.79**	**1.49**	0.38
Seeds[1]	0.12	0.10	0.05	0.06
Mean Kenaga Values --Turf (single rate 0.6 lb a.i./acre by ground boom sprayer) mean Kenaga -Represent the highest single rate for non-agricultural uses				
Short grass	**2.95**	**2.52**	**1.35**	0.34
Tall grass	**1.25**	**1.07**	0.57	0.14
Broadleaf plants	**1.56**	**1.33**	0.72	0.18
Fruits/pods	0.24	0.21	0.11	0.03
Arthropods	**2.26**	**1.93**	**1.03**	0.26
Seeds[1]	0.05	0.05	0.02	0.03
Upper Kenaga Values --Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre, 7-day interval and annual rate 0.5 lb a.i./A by aerial spray) -Represent the highest annual rate for agricultural uses				
Short grass	**5.71**	**4.87**	**2.61**	0.66
Tall grass	**2.62**	**2.23**	**1.20**	0.30
Broadleaf plants	**3.21**	**2.74**	**1.47**	0.37
Fruits/pods/seeds	0.36	0.30	0.16	0.04
Arthropods	**2.23**	**1.91**	**1.02**	0.26
Seeds[1]	0.08	0.07	0.04	0.04
Mean Kenaga Values --Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre, 7-day interval and annual rate 0.5 lb a.i./A by aerial spray) -Represent the highest annual rate for agricultural uses				
Short grass	**2.0**	**1.7**	0.93	0.23
Tall grass	0.86	0.73	0.39	0.10
Broadleaf plants	**1.1**	0.91	0.49	0.12
Fruits/pods/seeds	0.17	0.14	0.08	0.02
Arthropods	**1.6**	**1.3**	0.71	0.18
Seeds[1]	0.04	0.03	0.02	0.02
Upper Kenaga Values --Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre by aerial spray) - Represent the highest single rate for agricultural uses				
Short grass	**1.7**	**1.5**	0.79	0.20
Tall grass	0.80	0.68	0.36	0.09
Broadleaf plants	0.98	0.83	0.45	0.11
Fruits/pods	0.11	0.09	0.05	0.01
Arthropods	0.68	0.58	0.31	0.08
Seeds[1]	0.02	0.02	0.01	0.01
Mean Kenaga Values --Tuberous and corm vegetables subgroup (single rate 0.125 lb a.i./acre by aerial spray) - Represent the highest single rate for agricultural uses				
Short grass	0.61	0.52	0.28	0.07
Tall grass	0.26	0.22	0.12	0.03
Broadleaf plants	0.33	0.28	0.15	0.04
Fruits/pods/seeds	0.05	0.04	0.02	0.01
Arthropods	0.47	0.40	0.22	0.05
Seeds[1]	0.01	0.01	0.01	0.01
Corn seed treatment (single rate 0.00498 lb a.i./A) (or 0.00015 lb a.i./lb seeds x 33.2 lb seeds/A)				

Food Type	Chronic Dose-Based RQ NOAEL = 7.5 mg a.i./kg-bw			Chronic Dietary RQ NOAEC = 150 mg a.i./kg-diet
	Small (15 g)	Medium (35 g)	Large (1000 g)	
Corn seeds	0.04	0.04	0.02	N/A

Bolded values exceed the LOC for chronic risk LOC of 1.0. The endpoints listed in the table are used to calculate the RQ.

[1] Seeds presented separately for dose based RQs due to difference in food intake of granivores compared with herbivores and insectivores. This difference reflects the difference in the assumed mass fraction of water in their diets.

Spray Drift Risk

As described in **Section 9.1.3**, AgDRIFT™ (version 2.1.1) was used to model the drift distance to the LOC (*i.e.,* the distance extending from the edge of the field out to where the RQ exceeds the LOC). When modeling multiple spray drift events, the assumption is that the wind is blowing at the same speed and in the same direction. For mammals, spray drift resulting from multiple applications may increase the probability of offsite dietary exposure. This analysis suggests that the chronic risk LOCs for mammals are exceeded up to 20 and 49 feet from the use site for the multiple ground and aerial applications, respectively (**Table 9-8).** For a single application, chronic risk LOCs are exceeded up to 3 and 7 feet for birds and mammals, respectively.

Table 9-8. Spray drift distances offset to reduce the chronic risk to mammals

Crops	Highest Exceeding RQ	App Rate (lbs a.i./A)	Aerial (feet)	Ground (feet)
Multiple applications on non-agricultural turf and agricultural tuberous and corm vegetables				
Non-Agricultural turf	19	2 (max annual rate)	NA	20
Agricultural vegetables	5.7	0.5 (max annual rate)	49	7
Single applications on non-agricultural turf and agricultural tuberous and corm vegetables				
Non-Agricultural turf	8.3	0.6 (max single rate)	NA	10
Agricultural vegetables	1.7	0.125 (max single rate)	0	3

NA: Not applicable because metconazole is only applied to using ground equipment.

9.2.3 Exposure Risk from Consumption of Aquatic Organisms

As described in **Section 9.1.3**, the KABAM model (version 1.0) was used to evaluate the potential exposure and risk of direct effects to mammals via ingestion of residues in aquatic prey items that had bioaccumulated metconazole through various levels of the aquatic food chain. The KABAM modeling results (**Table 9-9**) show that all RQs for birds and mammals that consume aquatic organisms are above concern levels (chronic LOC = 1), but RQs do not exceed acute LOC (0.5) at the 1-in-10-year maximum 21-day mean EEC of 235 µg/L for pore water and 238 µg/L for

water column generated from the PWC model (**Table 9-2**). Therefore, there are chronic risk concerns for piscivorous birds and mammals via food chain bioaccumulation.

Table 9-9. RQ values for mammals and birds consuming fish contaminated by Metconazole

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.059	N/A	**36**	**6.5**
rice rat/star-nosed mole	0.071	N/A	**43**	**6.4**
small mink	0.088	N/A	**53**	**8.5**
large mink	0.097	N/A	**59**	**8.5**
small river otter	0.10	N/A	**63**	**8.5**
large river otter	0.12	N/A	**70**	**8.7**
Avian				
sandpipers	0.12	0.25	N/A	**1.1**
cranes	0.006	0.25	N/A	**1.1**
rails	0.062	0.29	N/A	**1.3**
herons	0.010	0.30	N/A	**1.3**
small osprey	0.016	0.34	N/A	**1.4**
white pelican	0.007	0.34	N/A	**1.5**

Bolded values exceed the acute LOC of 0.1 and chronic LOC of 1.

10. TERRESTRIAL INVERTEBRATE RISK ASSESSMENT

Because metconazole is a systemic triazole fungicide, it is expected to be taken up and distributed throughout treated plants. Exposure of terrestrial invertebrates to metconazole is expected to all lifestages of the invertebrates feeding on the plant foliars, stems and roots. For terrestrial invertebrate risk assessment, honeybees are used as the surrogate species which may not cover the habitat, lifecycles and exposure consequeces for other invertebrates. Therefore, the interpretation for the risk conclusion and characterization should be caution for other invertebrates from this screen level assessment.

10.1 Bee Exposure Assessment

Many of the registered uses of metconazole are attractive to bees (USDA 2017). Of the registered uses, the highest use rates are in ornamentals and residential turf, which are attractive to bees. The uses on golf courses and sod farm turf may not be attractive to bees, but bees may be exposed via spray drift from these uses in areas adjacent to treated fields.

Foliar Application

For foliar application, the bee exposure pathways of concern for metconazole foliar applications would be contact exposure due to direct spray onto foraging bees or ingestion of residue in pollen and nectar contaminated by plant translocation or direct spray onto flowers. This exposure would apply to both on-field applications to blooming pollinator-attractive crops and to drift to bee attractive vegetation adjacent to the application site.

Crop Attractiveness to Bees

Crops to which metconazole is applied are listed in **Table 10-1** along with the USDA bee attractiveness data for those crops (USDA, 2018) to identify which crops may represent direct exposure to bees on the field. Off-field (spray drift) assessments are conducted for foliar sprays regardless of whether the target crop is attractive or not. Bees may be exposed on the field to many different crops and non-agricultural turf and ornamentals plants. Although not included in USDA's crop attractiveness list, the pollen and nectar of ornamentals is assumed to be attractive to honeybees, bumble bees (*Bombus* spp.), and solitary bees. While residential ornamental and turf plants will attract pollinators, turf for agricultural (*i.e.,* sod) and managed uses (*i.e.,* golf course) is not considered a bee attractive crop. However, off-field risks are considered because these areas may contain pollinator attractive plants.

Bees (both *Apis* and non-*Apis*) may be exposed on the field to bee attractive crops treated with metconazole. Crops may be considered unattractive to bees based on two criteria: 1) pollen and nectar are not attractive to bees; and, 2) the crop is harvested prior to bloom. **Table 10-1** lists crop attractiveness to honeybees, bumble bees, and/or solitary bees. Bees may not be exposed on-field to some crops such as onions, sugar beets, carrots, broccoli, brussels sprouts, lettuce, and spinach because they are harvested prior to bloom. However, under seed production, these crops are considered attractive to bees. Some non-seed crops are not bee attractive and therefore, on field-risk is considered low, this list includes, barley, oats, rice, wheat, pistachios; and sugarcane.

Table 10-1. Summary of the Attractiveness of Registered Use Patterns for Metconazole to Bees

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.[3]	Notes
Berries Crop Group 13					
Blueberries *(Vaccinium corymbosum)*	Y (nectar & pollen)[2]	Yes[2]	*Andrena, Colletes, Osmia, Anthophora, Xylocopa*[2]	N/A	Acreage is only for cultivated blueberries; *Apis M.* and Megachilidae used in commercial pollination.

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.[3]	Notes
Caneberries *(Rubus)*	No	Yes[1]	Yes[1]	N/A	
Grapes (Vitus vinifera)	Y (pollen)[1]	No	Yes[1]	N/A	Wind pollinated.
Strawberries *(Fragaria* spp.)	Y (nectar & pollen)[1]	Yes[1]	*Andrena*, Halictids, *Osmia*[1]	47990	Not essential, but some growers add supplemental hives to compliment wind pollination.
Bulb Vegetables- Crop Group 3					
Garlic *(Liliaceae)*	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	N/A	Rarely grown for seed, harvested prior to bloom.
Onions *(Liliaceae)*	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	N/A	Harvested prior to bloom. Only a small % of acreage is grown for seed, but locally important (CA, AZ).
Root and Tuber- Crop Group 1					
Sugar Beets (*Beta vulgaris var. altissima*)	No	Yes[1]	Yes[1]	N/A Surveyed but no usage reported	Harvested prior to bloom. Requires pollination for breeding only, which is a small % of total acreage.
Potatoes *(Solanum tuberosum)*	No	Yes	*Andrena* [1]	109140	Only small % of acreage is grown for breeding. **Foliar and soil applications.**
Carrots *(Daucus carota)*	Y (nectar & pollen)[1]	Yes[1]	*Megachile rotundata*[1]	N/A Surveyed but no usage reported	Harvested prior to bloom. Requires pollination for seed production only

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.[3]	Notes
Cereal Grains Crop Group 15					
Barley *(Hordeum spp.)*	No	No	No	N/A	Wind pollinated
Corn *(Zea mays)*	Y (pollen)[1]	Yes[1]	Yes[1]	N/A	Wind pollinated, but can be visited during pollen shedding
Oats *(Avena spp., Avena sativa)*	No	No	No	N/A	Wind pollinated
Rice (*Oryza spp., mainly Oryza sativa*)	No	No	No	N/A	
Wheat *Triticum* spp.: common (*T. aestivum*), durum (*T. durum*), spelt (*T. spelta*).	No	No	No	N/A	
Citrus-Crop Group 10					
Grapefruit *(Citrus maxima; C. grandis; C. paradisi)*	Y (nectar & pollen)[2]	Yes[2]	N/AV	N/A	
Lemons (*Citrus limon*)	Y (nectar & pollen)[2]	Yes[2]	N/AV	N/A	
Oranges (*Citrus sinensis*);	Y (nectar & pollen)[2]	Yes[2]	*Andrena, Xylocopa*[1]	N/A	Variable among orange cultivars; honeybees brought to groves for orange blossom honey
Tangelos (*Rutaceae*)	Y (nectar & pollen)[2]	Yes[2]	Yes[1]	N/A	Does not require or use managed pollinators except for small acreage (~2,500 acres) of tangelos in Florida
Tangerines (*Citrus reticulata*);	Y (nectar & pollen)[2]	Yes[2]	*Andrena, Xylocopa*[1]	N/A	Does not require or use managed pollinators except for small acreage (~8,300 acres) in Florida for tangerines and certain varieties of mandarins. **Tents are used to prevent pollination to create seedless fruit**

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive? [1, 2]	Solitary Bee Attractive? [1, 2]	Acreage in the U.S.[3]	Notes
Cucurbits- Crop Group 9					
Cucumbers *(Cucumis sativus)*	Y (nectar & pollen)[1]	Yes[1]	*Melissodes Andrena*[1]	N/A	
Pumpkins and Squash *(Cucurbita* spp.)	Y (nectar & pollen)[1]	Yes[2]	*Agapostemon, Melissodes, Peponapis*[1]	175	
Watermelons *(Citrullus vulgaris)*	Y (nectar & pollen)[1]	Yes[1]	*Agapostemon, Floridegus, Halictus, Hoplitus, Melissodes*[1]	1150	
Fruiting Vegetables-Crop Group 8-10					
Peppers (*Solanaceae)*	No	Yes[2]	Yes[1]	6730	
Tomatoes *(Lycopersicon esculentum)*	No	Yes[1]	Yes[1]	6390	
Legumes- Crop Group 6					
Beans, Green (*Phaseolus)*	Y (nectar & pollen)[1]	Yes[1]	N/AV	1280	Acreage is for snap beans
Peas, Green (*Pisum sativum*); field pea (*P. arvense*)	Y (nectar & pollen)[1]	Yes[1]	*Eucera, Xylocopa*[1]	22435	
Soybeans *(Glycine soja)*	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	N/A	
Oilseed Crop- Group 20					
Cotton *(Gossypium hirsutum*) (*Gossypium barbardense*)	Y (pollen)[1]	Yes[1]	*Halictus, Anthophora, Xylocopa, Megachile, Nomia, Ptilothrix*	673020	Historical use of bees for hybrid seed production; however, hybrid cotton seed production is no longer considered economically viable.
Sunflower *(Helianthus annuus)*	Y (nectar & pollen)[2]	Yes[2]	*Halictus*, *Dieunomia, Megachile, Melissodes, Svastra, Xylocopa*[2]	N/A	
Rape/Canola *(Brassica napus var. oleifera)*	Y (nectar & pollen)[2]	Yes[1]	*Megachile*[2]	N/A	
Herbs and Spices- Crop Group 19					
Peppermint *(Mentha spp.: M. piperita)*	Y (nectar[1] & pollen[2])	Yes[2]	Yes[1]	N/A	Peppermint oil is produced from vegetative growth, without flowering or seed production.
Celery (*Apiaceae*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	N/A	

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Acreage in the U.S.[3]	Notes
Non-Grass Animal Feed-Crop Group 18					
Alfalfa (*Medicago sativa*)	Y (nectar[2] & pollen[1])	Yes[1]	Alfalfa leaf cutting bee, Alkali bee[2]	20	Only a small percentage of alfalfa is grown for seed; typically using managed alfalfa leaf cutting bees, alkali bees or honeybees. **Timing of hay or silage harvest, relative to bloom, varies by agronomic practice**, with earlier cuts typically occurring prior to bloom and later cuts being harvested up to 25% bloom.
Tropical and Subtropical Fruit, Edible Peel Group- Crop Group 23:					
Apples *(Malus pumila*; *M. sylvestris*; *M. communis*; *Pyrus malus)*	Y (nectar & pollen)[2]	Yes[1]	*Andrena, Anthidium, Halictus, Osmia, Anthophora, Habropoda[2]*	28260	
Pears *(Pyrus communis)*	Y (nectar & pollen)[1]	Yes[1]	*Osmia, Andrena [1]*	22435	
Persimmon (*Diospyros kaki; D. virginiana*)	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	NA	
Leafy Vegetable Group- Crop Group 4-16					
Broccoli and Cauliflower *(Brassica oleracea)*	Y (nectar & pollen)[2]	Yes[1]	*Andrenidae, Nomadidae, Megachilidae[1]*	80	Harvested prior to bloom
Brussels Sprouts and Cabbage (*Brassicaceae)*	Y (nectar & pollen)[2]	Yes[1]	Yes[1]	95	Harvested prior to bloom.
Lettuce *(Lactuca sativa)*	Y (nectar & pollen)[1]	Yes[1]	Yes[1]	N/A	Harvested prior to bloom. Self-pollinating
Spinach *(Spinacia oleracea)*	No	No	No	N/A	Harvested prior to bloom.

Crop Name	Honeybee Attractive?[1,2]	Bumble Bee Attractive? [1, 2]	Solitary Bee Attractive? [1, 2]	Acreage in the U.S.[3]	Notes
Stone Fruit – Crop Group 12.					
Apricots *(Prunus armeniaca)*	Y (nectar & pollen)[2]	Yes[2]	*Osmia*[1]	N/A	
Cherries Mazzard, sweet cherry (*Prunus avium*; *Cerasus avium*); hard-fleshed cherry (var. *duracina*); heart cherry (var. *juliana*)	Y (nectar & pollen)[2]	Yes[1]	*Osmia*[2]	N/A	
Peaches/Nectarines *(Prunus persica*; *Amygdalus persica*; *Persica laevis)*	Y (nectar & pollen)[1]	Yes[1]	*Osmia*[1]	160	
Plums/Prunes *(Prunus domestica*)	Y (nectar & pollen)[1]	Yes[1]	*Osmia, Anthophora*[1]	N/A	
Tree Nuts- Crop Group 14.					
Almonds *(Prunus amygdalus*; *P. communis*; *Amygdalus communis)*	Y (nectar & pollen)[2]	Yes[1]	*Osmia*[1]	N/A	
Hazelnuts *(Corylus avellana)*	Y (nectar & pollen)[1]	No	No	N/A	
Pecans (*Juglandaceae*)	Y (nectar & pollen)[1]	No	No	N/A	Wind pollinated
Pistachios *(Pistacia vera)*	No	No	No	N/A	Wind pollinated
Walnuts *(Juglans spp)*	Y (pollen)[1]	No	No	N/A	Wind pollinated
Miscellaneous					
Sugar cane *(Saccharum Officinarum)*	No	No	No	N/A	Wind pollinated
Peanuts *(Arachis hypogaea)*	Y (pollen)[1] N/AV (nectar)	Yes[1]	*Lasioglossum, Megachile, Anthidium, Nomia*[1]	99195	
Hops (Humulus lupulus)	Y (pollen)[1]	Yes[1]	No	N/A	Wind pollinated

[1] attractiveness rating is a single "+", denoting a use pattern is opportunistically attractive to bees.

[2]attractiveness rating is a double "++" denoting a use pattern is attractive in all cases.

[3] Annual Average acres between 2004 – 2017, N/A = Not available

Exposure to Terrestrial Invertebrates

The Bee-REX model (Version 1.0) calculates default (*i.e*., high end, yet reasonably conservative) EECs for contact and dietary routes of exposure for foliar, soil, and seed treatment applications. Further information about the Bee-REX model, including a summary of the methods used for deriving the default Tier I EECs can be found in the User Guide[6].

The foliar spray exposure would apply to both on-field applications to blooming pollinator-attractive crops as well as via drift to off-field pollinator attractive vegetation off the application site. To investigate the on- and off-field exposure route, EECs (pollen, nectar and contact) were estimated using BeeRex v 1.0 model (**See input and output in Appendix F**) at the maximum pre-bloom single application rate for residential turf, ornamental plants and tuberous/corm vegetables(**Table 10-2**). Aerial applications of metconazole can be made to agricultural tuberous/corm vegetables but not to non-agricultural turf and ornamental plants.

Table 10-2. Oral and Contact EECs for Honeybees

Crop (maximum Single Rate) (pre-bloom/at bloom)	**Exposure Category**	**EECs**
Foliar Spray		
Residential Turf (0.6 lbs a.i./A)	Pollen and Nectar:	66 mg a.i./kg
	Maximum Dietary Dose	19 µg a.i./bee
	Worker contact exposure	2.0 µg a.i./bee
	Larval bee	8.2 µg a.i./bee
Ornamentals (0.272 lbs a.i./A)	Pollen and Nectar:	29.9 mg a.i./kg
	Maximum Dietary Dose	8.7 µg a.i./bee
	Worker contact exposure	0.93 µg a.i./bee
	Larval bee	3.7 µg a.i./bee
Tuberous and corm vegetables/Rape (0.125 lbs a.i./A)	Pollen and Nectar:	13.8 mg a.i./kg
	Maximum Dietary Dose	4.0 µg a.i./bee
	Worker contact exposure	0.43 µg a.i./bee
	Larval bee	1.7 µg a.i./bee
Corn seed treatment (single rate 0.00498 lb a.i./A) (or 0.00015 lb a.i./lb seeds x 33.2 lb seeds/A)		
Corn	Pollen and Nectar:	1 mg a.i./kg
	Maximum Dietary Dose	0.29 µg a.i./bee
	Worker contact exposure	0.062 µg a.i./bee
	Larval bee	0.12 µg a.i./bee

Metconazole Residues in Pollen, Nectar and Whole Flowers

As a broad-spectrum systemic triazole fungicide, metconazole is sprayed on the plants and quickly absorbed into plant tissue including flowers, pollen and nectars which may contain

[6] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#terrestrial

residues that are available to bees for acute and chronic exposure. Metconazole residues in pollen, nectar and whole flowers were reported for sunflower *(Helianthus annuus)* (MRID 49459604) and winter oilseed rape *(Brassica napus* L.) (MRID 49459605) following a single field application of BAS 556 03 F (13% pyraclostrobin and 8% metconazole) product at 0.71 lb a.i./A metconazole in Germany which exceeds the labeled max single rates at 0.6 lb a.i./A in USA. Neverthless, the residues found in nectar, pollen and flower heads from above studies (**Table 10-3**) were compared with the EEC (78 mg a.i./kg) in pollen and nectar generated by BeeRex (1.0) based on the foliar application of 0.71 lb a.i./A. The EEC (78 mg a.i./kg) by the BeeRex model is about two orders of magnitude higher than the metconazole residues reported on sunflower (0.33, 11 and 0.81 mg/Kg in nectar, pollen and flower heads, respectively) (MRID 49459604) and oilseed rape (0.31, 4.6 and 21 mg/Kg in nectar, pollen and flowers, respectively) (MRID 49459605). Although the field residues in pollen, nectar, and whole flowers were collected at two time perious within 24 hours of application and 6-7 days after the application, the BeeRex model estimation is still more conservative.

Table 10-3. Metconazole Residue Concentration in Pollen, Nectar and Whole Flowers

Non-Guideline Residue Study	TEP BAS 556 03F 13% pyraclostrobin and 8% metconazole	Sunflower (*Helianthus annuus*)	Maximum Metconazole Residues Nectar = 0.33 mg/kg Pollen = 11.00 mg/kg Flowers = 0.81 mg/kg	49459604 Supplemental	Single field application at 0.71 lb a.i./A metconazole and 1.27 lb a.i./A pyraclostrobin
		Oilseed rape (*Brassica napus*)	Maximum Metconazole Residues Nectar = 0.31 mg/kg Pollen = 4.6 mg/kg Flowers = 21 mg/kg	49459605 Supplemental	

10.2 Bee Risk Characterization

Estimation of Risk Quotient (RQ)

To evaluate risk to terrestrial invertebrates, the highest single application rate that is registered for a bee attractive crop that produces both pollen and nectar was chosen (*i.e.,* 0.6 lb a.i. /A on residential turf plants). To bracket the potential impact range for bees, application rates at 0.272 lb a.i./A on ornamental plants and 0.125 lb a.i./A on tuberous and corm vegetables (subgroup 1C), stone fruits (crop group 12-12), sunflower (subgroup 20B) and rapeseed subgroup 20A) were also modeled. **Table 10-4** includes the EECs and RQs for adult and larval bees. This table also includes the most sensitive acute and chronic endpoints available for adult and larval honeybees exposed to metconazole. The BeeREX model output is available in **Appendix F**.

Table 10-4. EECs and RQs for Honeybees (Adults and Larvae) Generated Using BeeREX.

Life Stage	Description	Toxicity Value (µg a.i./bee) [1]	0.125 lb a.i./A (Ag vegetables)		0.272 lb a.i./A (Ornamental)		0.6 lb a.i./A (Turf)	
			EEC	RQ	EEC	RQ	EEC	RQ

			(µg a.i./bee)		(µg a.i./bee)		(µg a.i./bee)	
Adult	Acute contact LD_{50}	>95.3	4	NC	8.7	NC	19	NC
	Acute oral LD_{50}	88	4	0.05	8.7	0.10	19	0.22
	Chronic oral NOAEL	5.43	4	0.74	8.7	**1.61**	19	**3.55**
Larval	Acute LD_{50}	>101	1.7	NC	3.7	NC	8.2	NC
	Chronic NOAEL	2.9	1.7	0.59	3.7	**1.28**	8.2	**2.81**

[1]TGAI exposure
NC = not calculated because of non-definitive endpoints

RQs were not calculated for acute exposures of adult (contact) and larval bees because all available acute toxicity endpoints were non-definitive. Comparing the highest tested levels in the toxicity studies to the EECs indicates that the estimated exposure is at least an order of magnitude below tested levels where no mortality was observed. Acute adult and larval toxicity endpoints are >95.5 µg a.i./bee (MRID 46808485) and >101 µg a.i./larva (MRID 50200404), respectively which is about 5.0 – 12.3 times higher than the maximum EEC (19 µg a.i./bee and 8.2 µg a.i./larva) generated by BeeREX (**Table 10-4**). For acute oral exposure of adult bees, RQs range from 0.05 to 0.22 for three application rates (0.125, 0.272 lb and 0.6 a.i./A) on non-agricultural and agricultural flowering crops. This indicates that risk of mortality to adult bees from acute exposure is expected to be low.

BeeREX was used to generate RQs using the available chronic toxicity endpoints for adult and larval bees. Chronic risk exceeds the LOC (1.0) for adult bees (RQs = 1.61 ornamental and 3.55 residential turf uses) and larval bees (RQs = 1.28 ornamental and 2.81 residential turf uses) (**Table 10-4**). For the rest of agricultural flowering crops at 0.125 lbs a.i./A, the RQs for adult bees (0.74) and larval bees (0.59) do not exceed the LOC (1). For residential turf uses, the EEC (19 µg a.i./bee) for adult bees exceeds the LOAEC (11.1 µg a.i./bee) based on 28.3% mortality and also the EEC (8.2 µg a.i./bee) for larval bees exceeds the LOAEC (5.8 µg ai/larva) based on 27% reduced adult emergence. Consequently, it can be concluded that the chronic exposure risk to adult and larval bees is only limited to the application rates ≥0.215 lbs a.i./A estimated by the formular Chronic LOC (1) = 0.215 lbs a.i./A x 1.28 (RQ) /0.272 lbs a.i./A = 1(RQ).

Spray drift

Drift distances for chronic exposure of adult and larval bees extended up to 3.3 feet for ground spray on residential turf and ornamental plants at 0.6 lbs a.i./A and 0.272 lbs a.i./A, respectively (**Table 10-3**). Therefore, risk from off field exposure beyond 3.3 feet is considered low.

Table 10-3. Spray drift distances to bee foraging distance offset based on acute and chronic LOC

	Crops	Exceeding RQ (chronic)	LOC	Fraction of Applied (LOC/RQ)	App Rate (lbs a.i./A)	Ground* (feet)
Adult	Residential turf	3.55	1	0.29	0.6	3.3

	Ornamentals	1.61	1	0.62	0.272	3.3
Larvae	Residential turf	2.81	1	0.36	0.6	3.3
	Ornamentals	1.28	1	0.78	0.272	3.3

* Low boom, fine-medium/coarse droplets

Incident Reports for bees

An Iowa apiary reported that a plane sprayed within 1/4 mile of the hives without warning beekeepers in 2014 and no bee mortality was reported. Another two incidents with undetermined legality were reported, but the incidents are classified as "unlikely" to be related to metconazole because insecticides were also present (in one case clothianidin was detected in bee tissue and in the other case bees may have been exposed to fenpropathrin and imidacloprid).

11. TERRESTRIAL PLANT RISK ASSESSMENT

The RQs for terrestrial (<0.1) and semi-aquatic plants (0.29) are below the LOC (1) for the highest application rate on turf (0.6 lb a.i/A) (**Appendix G**). Therefore, there are no risk concerns for terrestrial and semi-aquatic plants for all uses. One minor plant incident was reported in the aggregate incident database that involved metconazole and pyraclostrobin in 2016.

12. CONCLUSIONS

This assessment concludes that there are no acute risk concerns to freshwater and estuarine/marine fish and aquatic invertebrates, mammals, piscivorous birds and mammals, adult terrestrial invertebrates, and terrestrial plants. Risk concerns were identified for the following: Chronic risk to birds, mammals, honeybee larvae, freshwater fish (aquatic-phase amphibians), estuarine/marine fish, and freshwater invertebrates. For acute exposure, there is risk of mortality to birds (reptiles, terrestrial-phase amphibians). There are chronic risk concerns for piscivorous birds and mammals via food chain bioaccumulation. In addition, there are risk concerns for growth effects to aquatic vascular and non-vascular plants. Metconazole has a log Kow of 3.85 which suggests a potential for bioconcentration. There are acute and chronic risk concerns for piscivorous birds and mammals via food chain bioaccumulation. Potential fate concerns identified are listed in **Table 12-1**.

Table 12-1. Potential Environmental Fate Concerns Identified for Metconazole

Bioconcentration/ Bioaccumulation[1]	Groundwater Contamination	Sediment	Persistence[1]	Residues of Concern	Volatilization
Likely log K_{ow}= 3.85	Unlikely	No	Persistent	Parent compound only	No

[1] Persistence classification consistent with Goring *et al* (1975) applied to aerobic soil metabolism studies.

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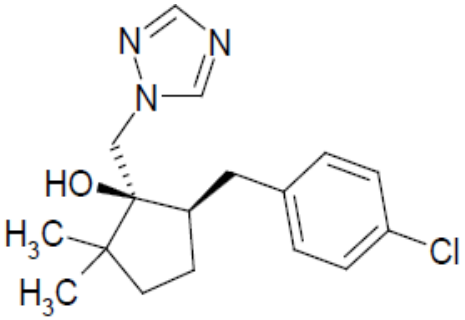
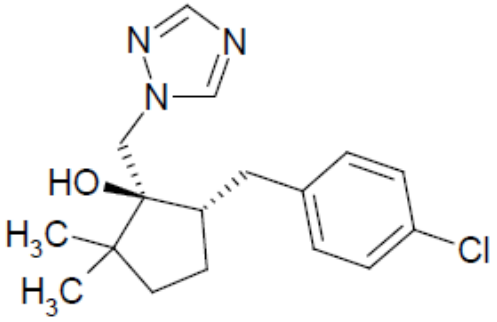
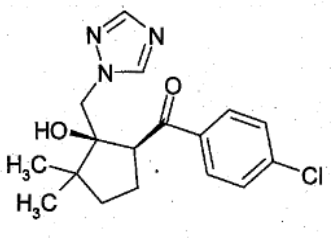
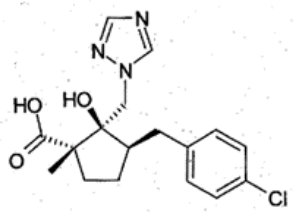
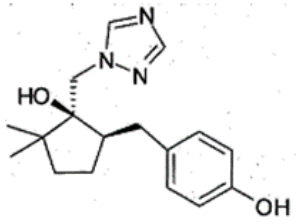
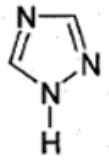
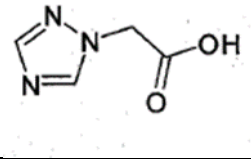
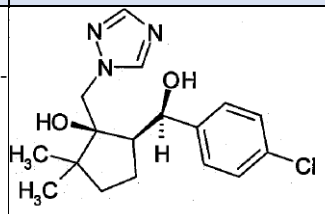
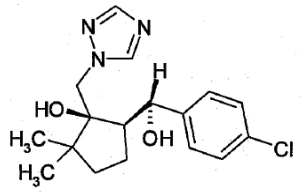
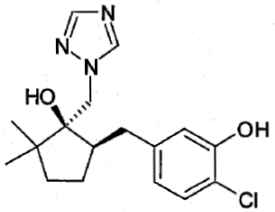
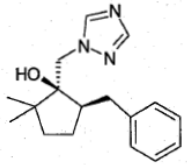
50828601	Hubbard, P., et al. 2018. Metconazole: A Dietary LC50 Study with the Zebra Finch. Unpublished study performed by Eurofins EAG Agroscience, LLC, Easton, Maryland. Laboratory Study No. 556B-104. Study sponsored by Kureha Corporation, Shinjuku-ku, Tokyo, Japan. Study initiated November 26, 2018 and completed April 4, 2019.
50200403	Kleebaum, K. 2014. Chronic Toxicity of BAS 555 F to the Honeybee *Apis mellifera* L. under Laboratory Conditions (Including Amendment No. 1). Study conducted by BioChem agrar Labor fur biologische und chemische Analytik GmbH, Gerichshain, Germany. Study sponsored by BASF SE. Laboratory Report ID 427946. Study conducted Aug. 2 – 12, 2013.
50200404	Kleebaum, K. 2015. Acute Toxicity of BAS 555 F to Honeybee Larvae (*Apis mellifera* L.) under Laboratory Conditions (*in vitro*). Study conducted by BioChem agrar Labor fur biologische und chemische Analytik GmbH, Gerichshain, Germany. Study sponsored by BASF SE Crop Protection Division, Ludwigshafen, Germany. Laboratory Report ID 13 10 48 008 B. Study conducted from Aug. 27 – Sept. 2, 2013.
50154601	Kleebaum, K. 2017. Repeated Exposure of Metconazole TGAI to Honey Bee (*Apis mellifera*) Larvae under Laboratory Conditions (*in vitro*). Study conducted by BioChem agrar Labor fur biologische und chemische Analytik GmbH, Gerichshain, Germany. Study sponsored by Kureha Corporation, Agrochemicals Department, Tokyo, Japan. Laboratory Project ID 16 10 48 115 B. Study conducted from Aug. 22 – Sept. 12, 2016.

APPENDIX A. METCONAZOLE AND ITS TRANFORMATION PRODUCTS

Table A.1. Metconazole and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT COMPOUND						
Metconazole	5-[(4-Chlorophenyl)methyl]-2,2-dimethyl-1-(1H- l,2,4-triazol-1-ylmethyl)cyclopentanol **CAS No.:** 125116-23-6 **Formula:** C17 H22 ON3 Cl **MW:** 319.8 g/mol **SMILES:**CC1(CCC(C1(CN2C=NC=N2)O)CC3=CC=C(C=C3)Cl)C	 **Cis-Metconazole**				
		 **Trans-Metconazole**				
MAJOR TRANSFORMATION PRODUCTS						
M30	2-Hydroxy-3,3-dimethyl-2-[1,2,4]triazol-1-ylmethyl-cyclopentyl-(4-chlorophenyl)- methanone **CAS No**.: 153208-73-2 **Formula:** C17 H20 O2 N3 Cl **MW:** 333.8 g/mol **SMILES:**CC1(CCC(C1(CN2C=NC=N2)O)CC3=CC=C(C=C3)Cl)C		Aerobic soil	46808408	13% (368 d)	13% (368 d)
			Aerobic aquatic	46902205	7.1% (152 d)	6.5% (182 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
M13	3-(4-chlorobenzyl)-2-hydroxy-1-methyl-2-[1,2,4]triazol-1-ylmethyl-cyclopentanecarboxylic acid **Formula:** C16 H18 O3 N3 Cl **MW:** 335.8 g/mol **SMILES:**C(=O)(O)C1C(O)(CN2C=NC=N2)C(Cc2ccc(Cl)cc2)CC1		Aerobic aquatic	46902205	10.9% (152 d)	10.3% (182 d)
M38 (Hydroxymetconazole) or (4-Chlorophenyl)[2-hydroxy-3,3-dimethyl-2-1H-1,2,4-triazol-1-ylmethyl)cyclopentanol]- methanone	(1RS,5RS,lRS,5SR)-5-(4-Hydroxybenzyl)-2,2-dimethyl-l- (lH-l,2,4-triazol-1- lylmethyl)cyclopentanol **Formula:** C17 H23 N3 O2 **MW:** 301.4 g/mol **SMILES:**c1cc(O)ccc1CC2CCC(C)(C)C 2(O)CN3N=CN=C3		Aqueous photolysis	46902202	14.5% (30 d)	14.5% (30 d)
				46808405	3.5% (5 d)	2.9% (14 d)
MINOR TRANSFORMATION PRODUCTS						
M20	1,2,4-triazole **Formula:** C2 H3 N3 **MW:** 69.07 g/mol **SMILES:** C1=NN=CN1		Aqueous photolysis	46808405	6.7% (14 d)	6.7% (14 d)
			Aerobic soil	46808408	3.92%(235 d)	3.64% (368 d)
M34	1H-1,2,4-Triazol-1 acetic acid		Aqueous photolysis	46808405	7% (14 d)	7% (14 d)

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
M21	(1R,2S,1αS)-α(p-Chlorophenyl)-2-hydroxy-3,3-dimethyl-2-(1H-1,2,4-triazol- 1-ylmethyl) cyclopentanemethanol		Aerobic soil	46808408	0.97% (49 d)	0.88% (368 d)
			Aerobic aquatic	46902205	7.9% (152 d)	5.4% (182 d)
M11	(5-[(4-Chlorophenyl)-hydroxy-methyl]-2,2-dimethyl-l-[l,2,4]triazol-l-yl-methyl-cyclopentanol)		Aerobic soil	46808408	3.5% (151 d)	3.5% (368 d)
			Aerobic aquatic	46902205	3.0% (62 d)	2.7% (182 d)
M15	2-Chloro-5-(2-hydroxyl-3.3-dimethyl-2-[1,2,4]triazol-1-ylmethyl-cyclopentylmethyl-phenol		Aerobic aquatic	46902205	2.0% (182 d)	2.0% (182 d)
M39	(1RS,5RS,lRS,SSR)-5-Benzyl-2,2-dimethyl-1-(lH-l,2,4-triazol-1-lylmethyl)cyclopentanol		Aqueous photolysis	46902202	7.9% (30 d)	7.9% (30 d)
				46808405	5.2% (5 d)	2.2% (14 d)

[A] AR means “applied radioactivity”. MW means “molecular weight”. ND means “not detected”. NA means “not applicable”.

APPENDIX B. ENDOCRINE DISRUPTOR SCREENING PROGRAM (EDSP)

As required by FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of the Draft Ecological Risk Assessment for Registration Review, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), metconazole is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

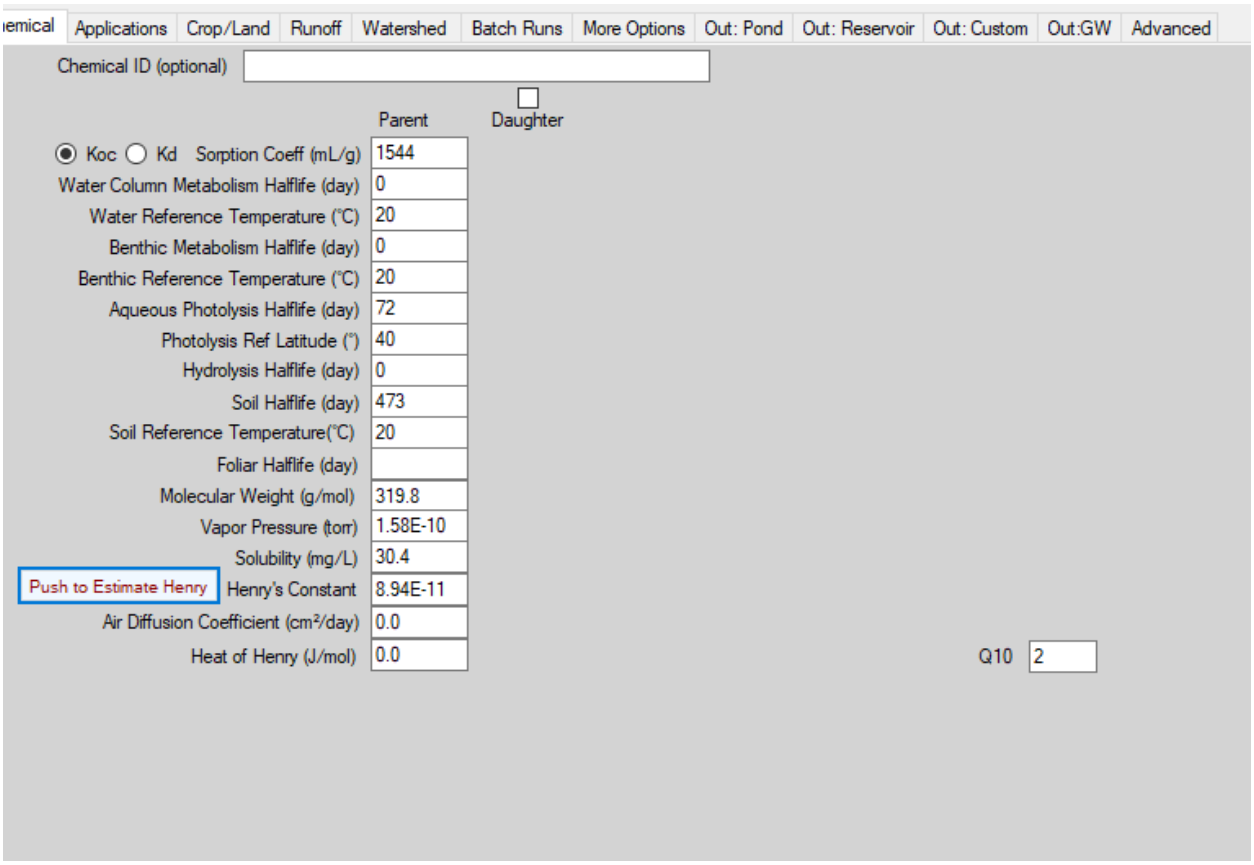
EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

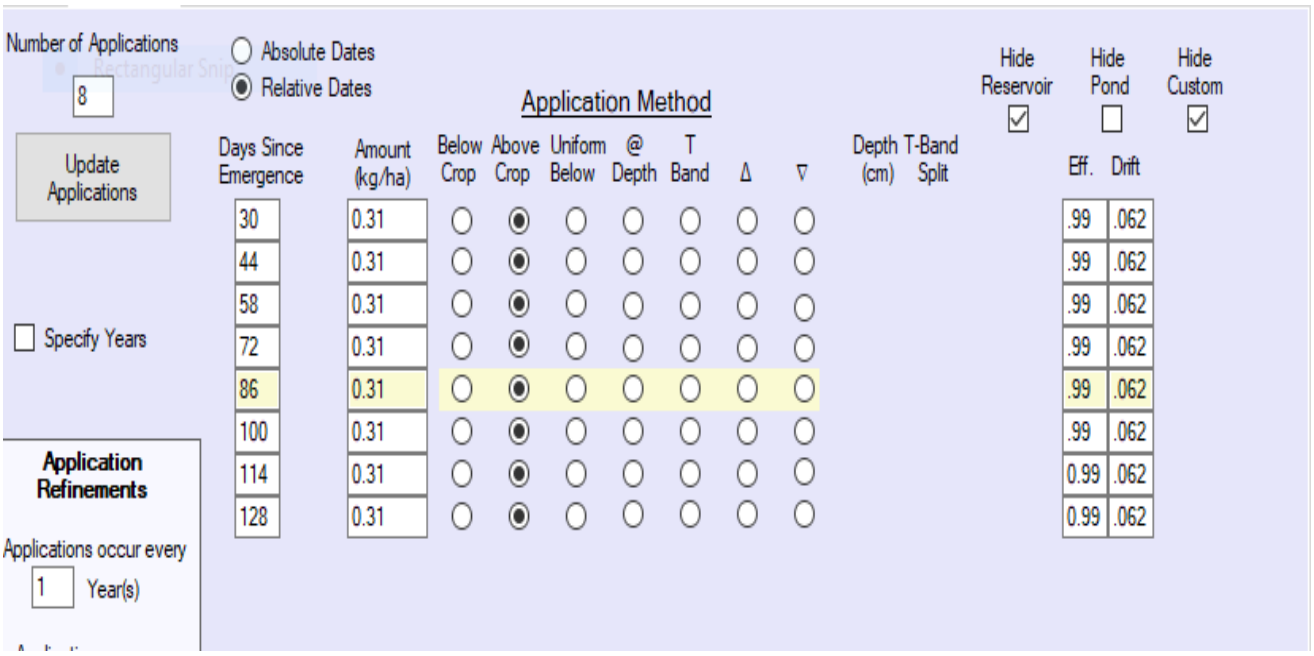
Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[1] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors. Metconazole is not on List 1. For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and Tier 1 screening battery, please visit our website[2].

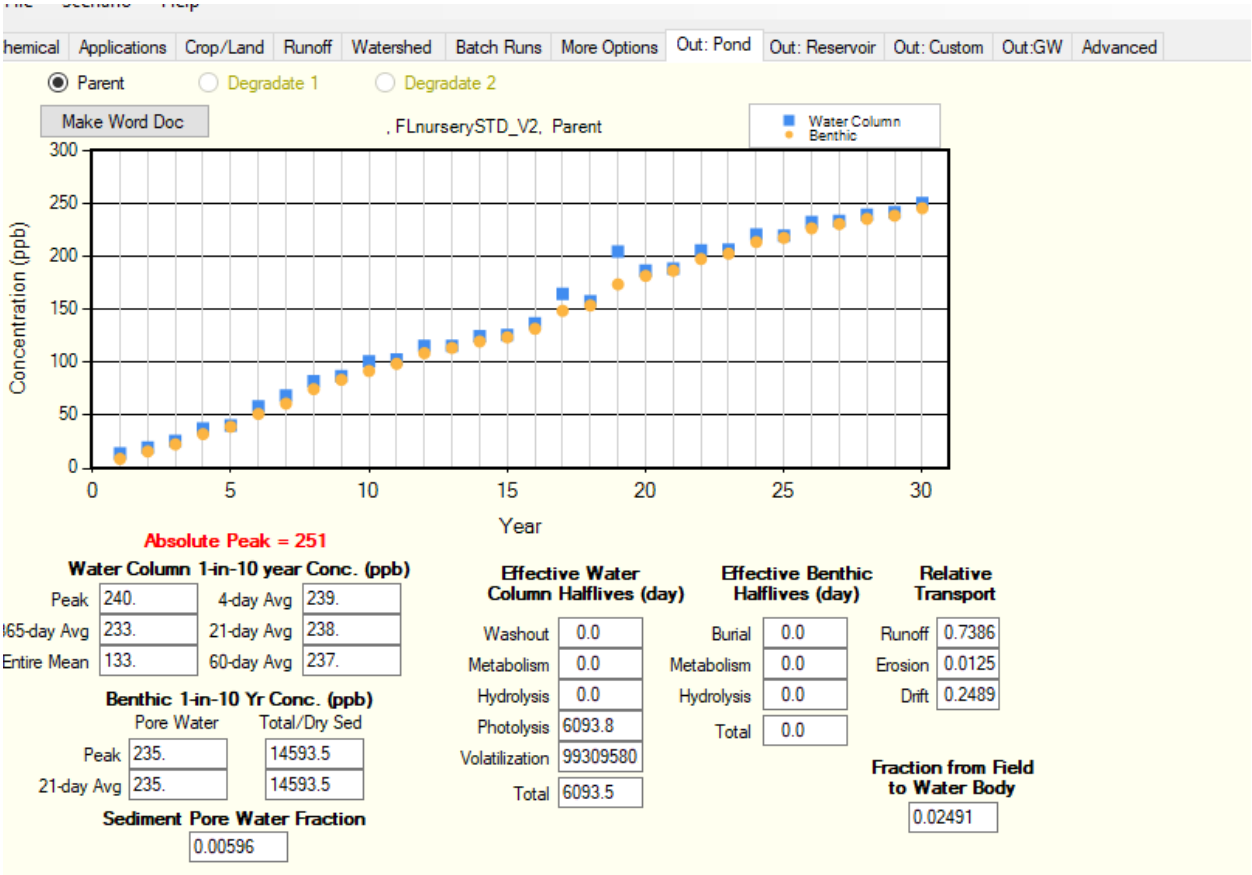
[1] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.
[2] Available: http://www.epa.gov/endo/

APPENDIX C. AQUATIC MODELING INPUTS AND OUTPUTS

Sample inputs and outputs for a FL nursery model run.




Number of Applications
8
Update Applications
Specify Years
Application Refinements
Applications occur every
1
Year(s)
Absolute Dates
Relative Dates
Application Method
Hide Reservoir
Hide Pond
Hide Custom
Days Since Emergence
Amount (kg/ha)
Below Crop
Above Crop
Uniform Below
@ Depth
T Band
Δ
∇
Depth (cm)
T-Band Split
Eff.
Drift
30 0.31 .99 .062
44 0.31 .99 .062
58 0.31 .99 .062
72 0.31 .99 .062
86 0.31 .99 .062
100 0.31 .99 .062
114 0.31 0.99 .062
128 0.31 0.99 .062


hemical
Applications
Crop/Land
Runoff
Watershed
Batch Runs
More Options
Out: Pond
Out: Reservoir
Out: Custom
Out:GW
Advanced
Parent
Degradate 1
Degradate 2
Make Word Doc
, FLnurserySTD_V2, Parent
Water Column
Benthic
Concentration (ppb)
Year
Absolute Peak = 251
Water Column 1-in-10 year Conc. (ppb)
Peak 240.
4-day Avg 239.
65-day Avg 233.
21-day Avg 238.
Entire Mean 133.
60-day Avg 237.
Benthic 1-in-10 Yr Conc. (ppb)
Pore Water
Total/Dry Sed
Peak 235. 14593.5
21-day Avg 235. 14593.5
Sediment Pore Water Fraction
0.00596
Effective Water Column Halflives (day)
Washout 0.0
Metabolism 0.0
Hydrolysis 0.0
Photolysis 6093.8
Volatilization 99309580
Total 6093.5
Effective Benthic Halflives (day)
Burial 0.0
Metabolism 0.0
Hydrolysis 0.0
Total 0.0
Relative Transport
Runoff 0.7386
Erosion 0.0125
Drift 0.2489
Fraction from Field to Water Body
0.02491

Summary of Water Modeling of Metconazole and the USEPA Standard Pond

Table 1. Estimated Environmental Concentrations (ppb) for Metconazole.

Peak (1-in-10 yr)	240.
4-day Avg (1-in-10 yr)	239.
21-day Avg (1-in-10 yr)	238.
60-day Avg (1-in-10 yr)	237.
365-day Avg (1-in-10 yr)	233.
Entire Simulation Mean	133.

Table 2. Summary of Model Inputs for Metconazole.

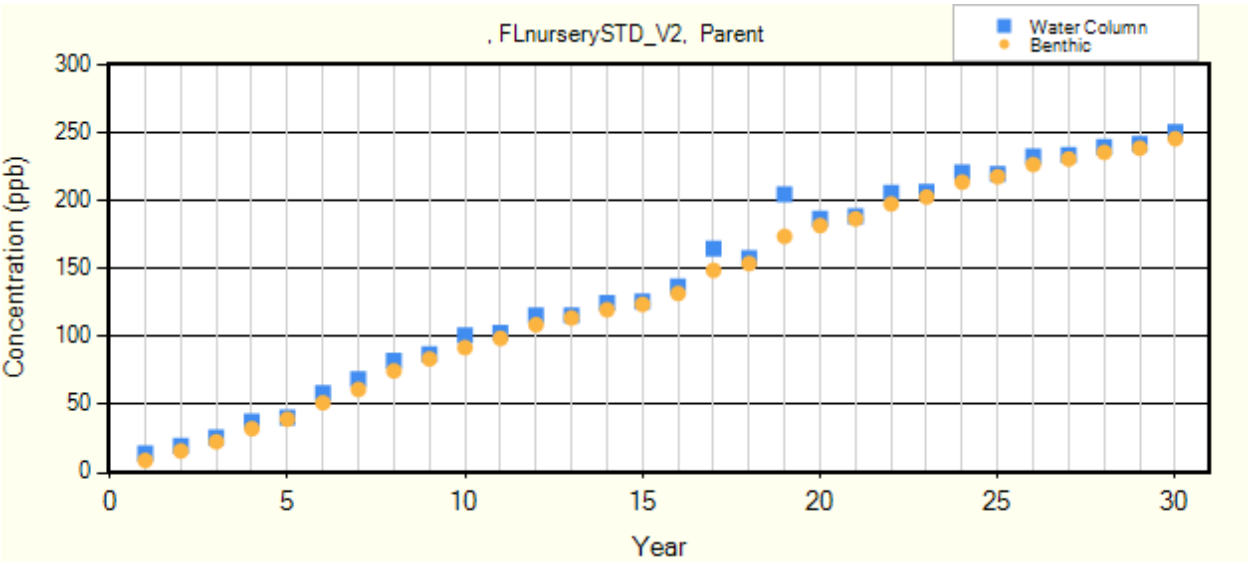
Scenario	FLnurserySTD_V2
Cropped Area Fraction	1
Koc (ml/g)	1544
Water Half-Life (days) @ 20 °C	0
Benthic Half-Life (days) @ 20 °C	0
Photolysis Half-Life (days) @ 40 °Lat	72
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 20 °C	473
Foliar Half-Life (days)	
Molecular Weight	319.8
Vapor Pressure (torr)	1.58E-10
Solubility (mg/l)	30.4
Henry's Constant	8.94E-11

Table 3. Application Schedule for Metconazole.

Date (Days Since Emergence)	Type	Amount (kg/ha)	Eff.	Drift

30	Above Crop (Foliar)	0.31	.99	.062
44	Above Crop (Foliar)	0.31	.99	.062
58	Above Crop (Foliar)	0.31	.99	.062
72	Above Crop (Foliar)	0.31	.99	.062
86	Above Crop (Foliar)	0.31	.99	.062
100	Above Crop (Foliar)	0.31	.99	.062
114	Above Crop (Foliar)	0.31	0.99	.062
128	Above Crop (Foliar)	0.31	0.99	.062

Figure 1. Yearly Peak Concentrations



APPENDIX D. OUTPUT FOR METCONAZOLE TERRESTRIAL MODELING

Table D-1. T-Rex Inputs for Turf at single and annual rate 0.6 lb and 2 lb a.i./acre, 14-day interval

Chemical Identity and Application Information	
Chemical Name:	Metconazole
Seed Treatment? (Check if yes)	☐ FALSE
Use:	perennial grass hay or pasture
Product name and form:	
% A.I. (leading zero must be entered for formulations <1% a.i.):	100.00%
Application Rate (lb ai/acre):	0.6
Half-life (days):	35
Application Interval (days):	14
Number of Applications:	4
Are you assessing applications with variable rates or intervals?	yes

Application No.	Rate	Day of Application
1	0.6	0
2	0.6	14
3	0.6	28
4	0.2	42

Upper Bound Kenaga Residues For RQ Calculation

Endpoints			
Avian	Bobwhite quail	LD50 (mg/kg-bw)	777.00
	Zebra Finch	LC50 (mg/kg-diet)	249.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Bobwhite quail	NOAEC (mg/kg-diet)	58.00
Mammals		LD50 (mg/kg-bw)	595.00
		LC50 (mg/kg-diet)	0.00

NOAEL (mg/kg-bw)	7.50
NOAEC (mg/kg-diet)	150.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	335.84
Tall Grass	153.93
Broadleaf plants	188.91
Fruits/pods/seeds	20.99
Arthropods	131.54

Avian Results

Avian Class	Body Weight (g)	Ingestion (Fdry) (g bw/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Small	20	5	23	114	2.28E-02
Mid	100	13	65	65	6.49E-02
Large	1000	58	291	29	2.91E-01
Granivores	20	5	5	25	5.06E-03
	100	13	14	14	1.44E-02
	1000	58	65	6	6.46E-02

Avian Body Weight (g)	Adjusted LD50 (mg/kg-bw)
20	559.77
100	712.62
1000	1006.60

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small 20	mid 100	large 1000
Short Grass	382.49	218.11	97.65
Tall Grass	175.31	99.97	44.76
Broadleaf plants	215.15	122.69	54.93
Fruits/pods	23.91	13.63	6.10
Arthropods	149.81	85.43	38.25
Seeds	5.31	3.03	1.36

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.68	0.31	0.10
Tall Grass	0.31	0.14	0.04
Broadleaf plants	0.38	0.17	0.05
Fruits/pods	0.04	0.02	0.01

Arthropods	0.27	0.12	0.04
Seeds	0.01	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	1.35	5.79
Tall Grass	0.62	2.65
Broadleaf plants	0.76	3.26
Fruits/pods/seeds	0.08	0.36
Arthropods	0.53	2.27

Mammalian Results

Mammalian Class	Body Weight	Ingestion (Fdry) (g bwt/day)	Ingestion (Fwet) (g/day)	% body wgt consumed	FI (kg-diet/day)
Herbivores/ insectivores	15	3	14	95	1.43E-02
	35	5	23	66	2.31E-02
	1000	31	153	15	1.53E-01
Granivores	15	3	3	21	3.18E-03
	35	5	5	15	5.13E-03
	1000	31	34	3	3.40E-02

Mammalian Class	Body Weight	Adjusted LD50	Adjusted NOAEL
Herbivores/ insectivores	15	1307.71	16.48
	35	1058.08	13.34
	1000	457.65	5.77
Granivores	15	1307.71	16.48
	35	1058.08	13.34
	1000	457.65	5.77

Dose-Based EECs (mg/kg-bw)	Mammalian Classes and Body weight (grams)		
	15	35	1000
Short Grass	320.20	221.30	51.31
Tall Grass	146.76	101.43	23.52
Broadleaf plants	180.11	124.48	28.86
Fruits/pods	20.01	13.83	3.21
Arthropods	125.41	86.68	20.10
Seeds	4.45	3.07	0.71

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	Small mammal 15 grams		Medium mammal 35 grams		Large mammal 1000 grams	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	0.24	19.42	0.21	16.59	0.11	8.89
Tall Grass	0.11	8.90	0.10	7.60	0.05	4.08
Broadleaf plants	0.14	10.93	0.12	9.33	0.06	5.00
Fruits/pods	0.02	1.21	0.01	1.04	0.01	0.56
Arthropods	0.10	7.61	0.08	6.50	0.04	3.48
Seeds	0.00	0.27	0.00	0.23	0.00	0.12

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	2.24
Tall Grass	#DIV/0!	1.03
Broadleaf plants	#DIV/0!	1.26
Fruits/pods/seeds	#DIV/0!	0.14
Arthropods	#DIV/0!	0.88

Table D-2. T-Rex Inputs for corn seed treatment 0.00015 lb a.i./lbs seed (0.00498 lb a.i./A)

Chemical	Metconazole				Data inputs are in blue
% a.i.	100%			Density of product (lbs/gal):	8.33
Endpoints	Reported	Tested Body Weight (g)	Adjusted LD50	Size class for adjusted LD50	
Avian LD50	777.00	178	559.77	Small (20g)	
Avian rep NOAEC	58.00		712.62	Medium (100g)	
			1006.60	Large (1000g)	
Mammallian LD50	595.00	350	1307.71	Small (15g)	
Mammallian NOAEC	150.00		1058.08	Medium (35g)	
			457.65	Large (1000g)	
		Adjusted NOAEL for Mammals			
		Small (15g)	16.48		
		Medium (35g)	13.34		
		Large (1000g)	5.77		

Animal Size	Crop	Maximum Application Rate (lbs ai/A)	Maximum Seed Application Rate (mg ai/kg seed)	Avian Nagy Dose (mg ai/kg-bw/day)	Mammalian Nagy Dose (mg ai/kg-bw/day)	Available AI (mg ai ft-2)
Small	corn, all or unspecified	0.00	3.24	0.82	0.69	0.00
Medium				0.47	0.47	
Large				0.21	0.11	

Crop	Risk Quotients†					
	Avian (20 g)			Mammalian (15 g)		
	Acute (# 1)	Acute (# 2)	Chronic	Acute (# 1)	Acute (# 2)	Chronic
corn, all or unspecified	0.00	0.00	0.06	0.00	0.00	0.04
	Avian (100 g)			Mammalian (35 g)		
	Acute (# 1)	Acute (# 2)	Chronic	Acute (# 1)	Acute (# 2)	Chronic
corn, all or unspecified	0.00	0.00	0.06	0.00	0.00	0.04
	Avian (1000 g)			Mammalian (1000 g)		
	Acute (# 1)	Acute (# 2)	Chronic	Acute (# 1)	Acute (# 2)	Chronic
corn, all or unspecified	0.00	0.00	0.06	0.00	0.00	0.02

Acute RQ #1 = (mg ai /kg-bw/day) / LD50

Acute RQ #2 = mg ai ft-2 /(LD50*bw)

Avian Chronic RQ = mg kg-1 seed / NOAEL

Mammalian Chronic RQ = mg a.i./kg-bw/day / adjusted NOAEL

Animal	Nagy allometry Food ingestion value g/day
20 g Bird	5.1
15 g Mammal	3.2
100 g Bird	14.4
35 g Mammal	5.1
1000 g Bird	64.6
1000 g Mammal	34.0

APPENDIX E. TERRESTRIAL VERTEBRATE ANALYSIS FOR KABAM

Bioaccumulation Model Input and Output Values for Metconazole

Table 1. Chemical characteristics of Metconazole.		
Characteristic	**Value**	**Comments/Guidance**
Pesticide Name	**Metconazole**	**Required input**
Log K_{OW}	**3.85**	**Required input** Enter value from acceptable or supplemental study submitted by registrant or available in scientific literature.
K_{OW}	**7079**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
K_{OC} (L/kg OC)	**1544**	**Required input** Input value used in PRZM/EXAMS to derive EECs. Follow input parameter guidance for deriving this parameter value (USEPA 2002).
Time to steady state (T_S; days)	**4**	No input necessary. This value is calculated automatically from the Log K_{OW} value entered above.
Pore water EEC (µg/L)	**235**	**Required input** Enter value generated by PRZM/EXAMS benthic file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the pore water of the sediment. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. Select the EEC generated by PRZM/EXAMS which has an averaging period closest to the time to steady state calculated above. In cases where the time to steady state exceeds 365 days, the user should select the EEC representing the average of yearly averages. The peak EEC should not be used.
Water Column EEC (µg/L)	**238**	**Required input** Enter value generated by PRZM/EXAMS water column file. PRZM/EXAMS EEC represents the freely dissolved concentration of the pesticide in the water column. The appropriate averaging period of the EEC is dependent on the specific pesticide being modeled and is based on the time it takes for the chemical to reach steady state. The averaging period used for the water column EEC should be the same as the one selected for the pore water EEC (discussed above).

Table 2. Input parameters for rate constants. "calculated" indicates that model will calculate rate constant.

Trophic level	k_1 (L/kg*d)	k_2 (d^{-1})	k_D (kg-food/kg-org/d)	k_E (d^{-1})	k_M* (d^{-1})
phytoplankton	calculated	calculated	0*	0*	0
zooplankton	calculated	calculated	calculated	calculated	0
benthic invertebrates	calculated	calculated	calculated	calculated	0
filter feeders	calculated	calculated	calculated	calculated	0
small fish	calculated	calculated	calculated	calculated	0
medium fish	calculated	calculated	calculated	calculated	0
large fish	calculated	calculated	calculated	calculated	0

* Default value is 0.

k_1 and k_2 represent the uptake and elimination constants respectively, through respiration.

k_D and k_E represent the uptake and elimination constants, respectively, through diet.

k_M represents the metabolism rate constant.

Table 3. Mammalian and avian toxicity data for Metconazole. These are required inputs.

Animal	Measure of effect (units)	Value	Species	If selected species is "other," enter body weight (in kg) here.
Avian	LD_{50} (mg/kg-bw)	777	Northern bobwhite quail	
	LC_{50} (mg/kg-diet)	249	other	0.015
	NOAEC (mg/kg-diet)	58	Northern bobwhite quail	
	Mineau Scaling Factor	1.15	Default value for all species is 1.15 (for chemical specific values, see Mineau et al. 1996).	
Mammalian	LD_{50} (mg/kg-bw)	595	other	0.022
	LC_{50} (mg/kg-diet)	N/A	other	
	Chronic Endpoint	9.79	laboratory rat	
	units of chronic endpoint*	ppm		

*ppm = mg/kg-diet

Table 4. Abiotic characteristics of the model aquatic ecosystem.		
Characteristic	**Value**	**Guidance***
Concentration of Particulate Organic Carbon (X_{POC}; kg OC/ L)	0.00E+00	When using EECs generated by PRZM/EXAMS, use a value of "0" for both POC and DOC.
Concentration of Dissolved Organic Carbon (X_{DOC}; kg OC/L)	0.00E+00	
Concentration of Dissolved Oxygen (C_{OX}; mg O_2/L)	5.0	Default value is 5.0 mg O_2/L when using EECs generated by PRZM/EXAMS.
Water Temperature (T; ^oC)	15	Value is defined by the average water temperature of the EXAMS pond when using EECs generated by PRZM/EXAMS. Model user should consult output file of EXAMS to define this value.
Concentration of Suspended Solids (C_{SS}; kg/L)	3.00E-05	Default value is $3.00x10^{-5}$ kg/L when using EECs generated by PRZM/EXAMS.
Sediment Organic Carbon (OC; %)	4.0%	Default value is 4.0% when using EECs generated by PRZM/EXAMS.
*When using pesticide concentrations from monitoring data or mesocosm studies, consult Appendix B of the User's Guide for specific guidance on selecting values for these parameters.		

Table 5. Characteristics of aquatic biota of the model ecosystem.					
Trophic Level	**Wet Weight (kg)**	**% lipids**	**% NLOM**	**% Water**	**Do organisms in trophic level respire some pore water?**
sediment*	N/A	0.0%	4.0%	96.0%	N/A
phytoplankton	N/A	2.0%	8.0%	90.0%	no
zooplankton	1.0E-07	3.0%	12.0%	85.0%	no
benthic invertebrates	1.0E-04	3.0%	21.0%	76.0%	yes
filter feeders	1.0E-03	2.0%	13.0%	85.0%	yes
small fish	1.0E-02	4.0%	23.0%	73.0%	yes
medium fish	1.0E-01	4.0%	23.0%	73.0%	yes
large fish	1.0E+00	4.0%	23.0%	73.0%	no
*Note that sediment is not a trophic level. It is included in this table because it is consumed by aquatic organisms of the KABAM foodweb. N/A = not applicable					

Table 6. Diets of aquatic biota of the model ecosystem.						
	Diet for:					
Trophic level in diet	Zoo plankton	Benthic Invertebrates	Filter Feeder	Small Fish	Medium Fish	Large Fish
sediment*	0.0%	34.0%	34.0%	0.0%	0.0%	0.0%
phytoplankton	100.0%	33.0%	33.0%	0.0%	0.0%	0.0%
zooplankton		33.0%	33.0%	50.0%	0.0%	0.0%
benthic invertebrates			0.0%	50.0%	50.0%	0.0%
filter feeders				0.0%	0.0%	0.0%
small fish					50.0%	0.0%
medium fish						100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
*Note that sediment is not a trophic level. It is included in this table because it is consumed by aquatic organisms of the KABAM foodweb.						

Table 7. Identification of mammals and birds feeding on aquatic biota of the model ecosystem.		
Mammal/Bird #	Name	Body weight (kg)
Mammal 1	fog/water shrew	0.018
Mammal 2	rice rat/star-nosed mole	0.085
Mammal 3	small mink	0.45
Mammal 4	large mink	1.8
Mammal 5	small river otter	5
Mammal 6	large river otter	15
Bird 1	sandpipers	0.02
Bird 2	cranes	6.7
Bird 3	rails	0.07
Bird 4	herons	2.9
Bird 5	small osprey	1.25
Bird 6	white pelican	7.5

Table 8. Diets of mammals feeding on aquatic biota of the model ecosystem.						
	Diet for:					
Trophic level in diet	fog/water shrew	rice rat/star-nosed mole	small mink	large mink	small river otter	large river otter
phytoplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
zooplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
benthic invertebrates	100.0%	34.0%	0.0%	0.0%	0.0%	0.0%
filter feeders	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%
small fish	0.0%	33.0%	0.0%	0.0%	0.0%	0.0%
medium fish	0.0%	0.0%	100.0%	100.0%	100.0%	0.0%

large fish	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 9. Diets of birds feeding on aquatic biota of the model ecosystem.

Trophic level in diet	Diet for: sandpipers	cranes	rails	herons	small osprey	white pelican
phytoplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
zooplankton	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
benthic invertebrates	33.0%	33.0%	50.0%	50.0%	0.0%	0.0%
filter feeders	33.0%	33.0%	0.0%	0.0%	0.0%	0.0%
small fish	34.0%	0.0%	50.0%	0.0%	0.0%	0.0%
medium fish	0.0%	34.0%	0.0%	50.0%	100.0%	0.0%
large fish	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 10. Input parameters and calculations relevant to derivation of C_B.

Parameter	Phyto plankton	Zoo plankton	Benthic Invertebrates	Filter Feeders	Small Fish	Medium Fish	Large Fish
Equation A1							
C_B	**0.078842**	**0.05794074**	**0.063375**	**0.041737**	**0.082322**	**0.083445**	**0.08547**
C_{BD}	0.000000	0.00013774	0.000380	0.000245	0.001483	0.002815	0.005092
C_{BR}	0.07884181	0.05780300	0.06299570	0.04149156	0.08083901	0.08062975	0.08037413
C_S	0.014514						
C_{WDP}	0.00023500						
C_{WTO}	0.00023800						
k_1	1194.892	42157.680	3757.307	1678.327	749.681	334.870	149.581
k_2	3.507024	173.511631	14.169014	9.609624	2.199137	0.982318	0.438786
k_D	0.000000	0.303247	0.107596	0.047075	0.053926	0.038177	0.027027
k_E	0.000000	0.057251	0.014125	0.009383	0.005370	0.004724	0.003647
k_G	0.100000	0.012559	0.003155	0.001991	0.001256	0.000792	0.000500
k_M	0	0	0	0	0	0	0
m_o	1	1	0.95	0.95	0.95	0.95	1
m_p	0	0	0.05	0.05	0.05	0.05	0
$\Sigma (P_i * C_{Di})$	0	0.07884181	0.050072866	0.05007287	0.06065811	0.07284872	0.08344512
Φ	1.00000000						
Equation A2							
X_{POC}	0.0000000						
X_{DOC}	0.0000000						
K_{OW}	7079						
Φ	1.00000000						

Equation A4							
C_S	0.0145						
C_{SOC}	0.3628						
C_{WDP}	0.00024						
K_{OC}	1544						
OC	4%						
Equation A5							
C_{ox}	N/A	5					
E_W	N/A	0.534218189					
G_V	N/A	0.00789147	0.703328201	3.14165167	14.0332425	62.6841919	280
k_1	1194.8921	42157.6799	3757.307177	1678.32747	749.681342	334.870355	149.581093
K_{OW}	7079						
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
Equation A6							
k_1	1194.8921	42157.6799	3757.307177	1678.32747	749.681342	334.870355	149.581093
k_2	3.507024021	173.511631	14.16901369	9.60962402	2.19913714	0.98231848	0.43878555
K_{BW}	340.7139765	242.967458	265.1777505	174.65069	340.897949	340.897949	340.897949
K_{OW}	7079						
V_{LB}	0.02	0.03	0.03	0.02	0.04	0.04	0.04
V_{NB}	0.08	0.12	0.21	0.13	0.23	0.23	0.23
V_{WB}	0.9	0.85	0.76	0.85	0.73	0.73	0.73
B	0.35	0.035					
Equation A7							
k_G	0.1	0.01255943	0.003154787	0.00199054	0.00125594	0.00079245	0.0005
T	15						
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
Equation A8							
C_{ox}	N/A	N/A	N/A	5	N/A	N/A	N/A
C_{SS}	N/A	N/A	N/A	3.00E-05	N/A	N/A	N/A
E_D	N/A	0.499469604					
G_D	N/A	6.07E-08	2.15E-05	9.42E-05	1.08E-03	7.64E-03	5.41E-02
G_V	N/A	N/A	N/A	3.14	N/A	N/A	N/A
k_D	0	3.03E-01	1.08E-01	4.71E-02	5.39E-02	3.82E-02	2.70E-02
K_{OW}	7079						
T	N/A	15					
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
Equation A9							
C_{ox}	N/A	N/A	N/A	5	N/A	N/A	N/A
C_{SS}	N/A	N/A	N/A	3.00E-05	N/A	N/A	N/A
E_D	N/A	0.4995					
G_D	N/A	0.0000	0.0000	0.0000942	0.0011	0.0076	0.0541
G_F	N/A	0.000000	0.000015	0.000066	0.000726	0.004965	0.034777

G_V	N/A	N/A	N/A	3.1417	N/A	N/A	N/A
k_E	0	0.0573	0.0141	0.0094	0.0054	0.0047	0.0036
K_{GB}	N/A	0.2686	0.1870	0.2840	0.1482	0.1905	0.2099
K_{OW}	N/A	7079					
T	N/A	15					
V_{LB}	N/A	0.03	0.03	0.02	0.04	0.04	0.04
V_{LD}	N/A	0.02	0.01650	0.0165	0.03	0.035	0.04
V_{LG}	N/A	0.007966	0.005876	0.005876	0.003571	0.004311	0.004979
V_{NB}	N/A	0.12	0.21	0.13	0.23	0.23	0.23
V_{ND}	N/A	0.08	0.0796	0.0796	0.165	0.22	0.23
V_{NG}	N/A	0.03186	0.02835	0.02835	0.09819	0.13548	0.14315
V_{WB}	N/A	0.85	0.76	0.85	0.73	0.73	0.73
V_{WD}	N/A	0.9	0.9039	0.9039	0.805	0.745	0.73
V_{WG}	N/A	0.9602	0.9658	0.9658	0.8982	0.8602	0.8519
W_B	N/A	0.0000001	0.0001	0.001	0.01	0.1	1
B	N/A	0.035	0.035	0.035	0.035	0.035	0.035
ε_L	N/A	0.72	0.75	0.75	0.92	0.92	0.92
ε_N	N/A	0.72	0.75	0.75	0.6	0.6	0.6
ε_W	N/A	0.25	0.25	0.25	0.25	0.25	0.25
Calculation of BCF values							
C_{BCF}	0.081089926	0.05782626	0.063072528	0.04154067	0.08108258	0.08108258	0.08113371

Table 11. Estimated concentrations of Metconazole in ecosystem components.

Ecosystem Component	Total concentration (µg/kg-ww)	Lipid normalized concentration (µg/kg-lipid)	Contribution due to diet (µg/kg-ww)	Contribution due to respiration (µg/kg-ww)
Water (total)*	238	N/A	N/A	N/A
Water (freely dissolved)*	238	N/A	N/A	N/A
Sediment (pore water)*	235	N/A	N/A	N/A
Sediment (in solid)**	14,514	N/A	N/A	N/A
Phytoplankton	78,842	3942091	N/A	78,841.81
Zooplankton	57,941	1931358	137.74	57,803.00
Benthic Invertebrates	63,375	2112516	379.78	62,995.70
Filter Feeders	41,737	2086828	245.00	41,491.56
Small Fish	82,322	2058049	1,482.95	80,839.01
Medium Fish	83,445	2086128	2,815.36	80,629.75
Large Fish	85,466	2136645	5,091.67	80,374.13
* Units: µg/L; **Units: µg/kg-dw				

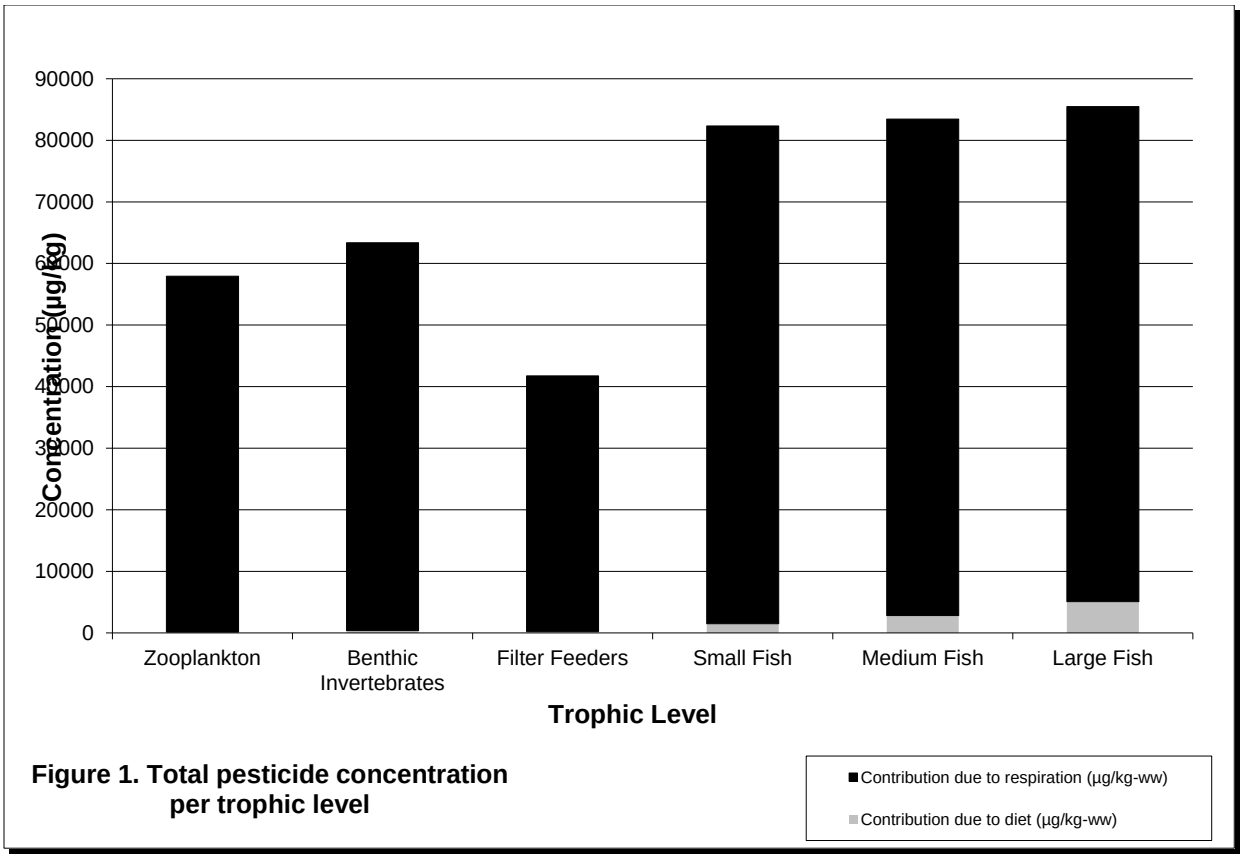


Figure 1. Total pesticide concentration per trophic level

Table 12. Total BCF and BAF values of Metconazole in aquatic trophic levels.

Trophic Level	Total BCF (µg/kg-ww)/(µg/L)	Total BAF (µg/kg-ww)/(µg/L)
Phytoplankton	341	331
Zooplankton	243	243
Benthic Invertebrates	265	266
Filter Feeders	175	175
Small Fish	341	346
Medium Fish	341	351
Large Fish	341	359

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of Metconazole in aquatic trophic levels.				
Trophic Level	**BCF (µg/kg-lipid)/(µg/L)**	**BAF (µg/kg-lipid)/(µg/L)**	**BMF (µg/kg-lipid)/(µg/kg-lipid)**	**BSAF (µg/kg-lipid)/(µg/kg-OC)**
Phytoplankton	17036	16563	N/A	11
Zooplankton	8099	8115	0.49	5
Benthic Invertebrates	8834	8876	1.09	6
Filter Feeders	8727	8768	1.08	6
Small Fish	8517	8647	1.02	6
Medium Fish	8517	8765	1.00	6
Large Fish	8522	8978	1.02	6

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by Metconazole.						
Wildlife Species	**Biological Parameters**				**EECs (pesticide intake)**	
	Body Weight (kg)	**Dry Food Ingestion Rate (kg-dry food/kg-bw/day)**	**Wet Food Ingestion Rate (kg-wet food/kg-bw/day)**	**Drinking Water Intake (L/d)**	**Dose Based (mg/kg-bw/d)**	**Dietary Based (ppm)**
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	37.123	63.38
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	30.264	62.49
small mink	0.5	0.079	0.293	0.048	24.500	83.45
large mink	1.8	0.062	0.229	0.168	19.145	83.45
small river otter	5.0	0.052	0.191	0.421	15.963	83.45
large river otter	15.0	0.042	0.157	1.133	13.447	85.47
Avian						
sandpipers	0.0	0.228	1.034	0.004	64.8487	62.68
cranes	6.7	0.030	0.136	0.211	8.5770	63.06
rails	0.1	0.147	0.577	0.010	42.0934	72.85
herons	2.9	0.040	0.157	0.120	11.5647	73.41
small osprey	1.3	0.054	0.199	0.069	16.6525	83.45

white pelican	7.5	0.029	0.107	0.228	9.1264	85.47

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by Metconazole.

Wildlife Species	Toxicity Values			
	Acute		Chronic	
	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)
Mammalian				
fog/water shrew	625.61	N/A	1.03	9.79
rice rat/star-nosed mole	424.39	N/A	0.70	9.79
small mink	279.78	N/A	0.46	9.79
large mink	197.84	N/A	0.33	9.79
small river otter	153.24	N/A	0.25	9.79
large river otter	116.44	N/A	0.19	9.79
Avian				
sandpipers	559.77	249.00	N/A	58
cranes	1338.97	249.00	N/A	58
rails	675.50	249.00	N/A	58
herons	1180.91	249.00	N/A	58
small osprey	1040.87	249.00	N/A	58
white pelican	1361.81	249.00	N/A	58

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by Metconazole.				
	Acute		Chronic	
Wildlife Species	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.059	N/A	**36.115**	**6.473**
rice rat/star-nosed mole	0.071	N/A	**43.402**	**6.383**
small mink	0.088	N/A	**53.298**	**8.524**
large mink	0.097	N/A	**58.899**	**8.524**
small river otter	**0.104**	N/A	**63.401**	**8.524**
large river otter	**0.115**	N/A	**70.287**	**8.730**
Avian				
sandpipers	**0.116**	**0.252**	N/A	**1.081**
cranes	0.006	**0.253**	N/A	**1.087**
rails	0.062	**0.293**	N/A	**1.256**
herons	0.010	**0.295**	N/A	**1.266**
small osprey	0.016	**0.335**	N/A	**1.439**
white pelican	0.007	**0.343**	N/A	**1.474**

APPENDIX F. OUTPUT FROM BEEREX FOR APPLICATION TO ORNAMENTALS

Table 1. User inputs (related to exposure)

Description	Value
Application rate	0.272
Units of app rate	lb a.i./A
Application method	foliar spray
Are empirical residue data available?	no

Table 2. Toxicity data

Description	Value (µg a.i./bee)
Adult contact LD50	>95.3
Adult oral LD50	88
Adult oral NOAEL	11
Larval LD50	>101
Larval NOAEL	2.9

Table 3. Estimated concentrations in pollen and nectar

Application method	EECs (mg a.i./kg)	EECs (µg a.i./mg)
foliar spray	29.92	0.02992
soil application	NA	NA
seed treatment	NA	NA
tree trunk	NA	NA

Table 5. Results (highest RQs)

Exposure	Adults	Larvae
Acute contact	#VALUE!	NA
Acute dietary	0.10	#VALUE!
Chronic dietary	0.79	1.28

Table 4. Daily consumption of food, pesticide dose and resulting dietary RQs for all bees

Life stage	Caste or task in hive	Average age (in days)	Jelly (mg/day)	Nectar (mg/day)	Pollen (mg/day)	Total dose (µg a.i./bee)	Acute RQ	Chronic RQ
Larval	Worker	1	1.9	0	0	0.00056848	#VALUE!	0.000196
		2	9.4	0	0	0.00281248	#VALUE!	0.00097
		3	19	0	0	0.0056848	#VALUE!	0.00196
		4	0	60	1.8	1.849056	#VALUE!	0.637606
		5	0	120	3.6	3.698112	#VALUE!	1.275211
	Drone	6+	0	130	3.6	3.997312	#VALUE!	1.378383
	Queen	1	1.9	0	0	0.00056848	#VALUE!	0.000196
		2	9.4	0	0	0.00281248	#VALUE!	0.00097
		3	23	0	0	0.0068816	#VALUE!	0.002373
		4+	141	0	0	0.0421872	#VALUE!	0.014547
Adult	Worker (cell cleaning and capping)	0-10	0	60	6.65	1.994168	0.022661	0.181288
	Worker (brood and queen tending, nurse bees)	6 to 17	0	140	9.6	4.476032	0.050864	0.406912
	Worker (comb building, cleaning and food handling)	11 to 18	0	60	1.7	1.846064	0.020978	0.167824
	Worker (foraging for pollen)	>18	0	43.5	0.041	1.30274672	0.01480394	0.118432
	Worker (foraging for nectar)	>18	0	292	0.041	8.73786672	0.09929394	0.794352
	Worker (maintenance of hive in winter)	0-90	0	29	2	0.92752	0.01054	0.08432
	Drone	>10	0	235	0.0002	7.031205984	0.07990007	0.639201
	Queen (laying 1500 eggs/day)	Entire lifestage	525	0	0	0.15708	0.001785	0.01428

APPENDIX G. TERRPLANT V1.2.2 INPUT AND OUTPUT EXAMPLE

Green values signify user inputs (Tables 1, 2 and 4).

Table 1. Chemical Identity.

Parameter	User Inputs
Chemical Name	Metconazole
PC code	
Use	Turf
Application Method	Ground spray
Application Form	
Solubility in Water (ppm)	30.4

Table 2. Input parameters used to derive EECs.

Input Parameter	Symbol	Value (user inputs)	Units
Application Rate	A	0.6	
Incorporation	I	1	none
Runoff Fraction	R	0.02	none
Drift Fraction	D	0.01	none

Table 3. EECs for Metconazole. Units in .

Description	Equation	EEC
Runoff to dry areas	(A/I)*R	0.012
Runoff to semi-aquatic areas	(A/I)*R*10	0.12
Spray drift	**A*D**	**0.006**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.018**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.126**

Table 4. Plant survival and growth data used for RQ derivation. Units are in . All values are user inputs

	Seedling Emergence		Vegetative Vigor	
Plant type	EC_{25}	NOAEC	EC_{25}	NOAEC
Monocot	0.78			
Dicot	0.15		0.44	

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Metconazole through runoff and/or spray drift.*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift
Monocot	non-listed	<0.1	0.16	<0.1
Monocot	listed	#DIV/0!	#DIV/0!	#DIV/0!
Dicot	non-listed	0.12	0.84	<0.1
Dicot	listed	#DIV/0!	#DIV/0!	#DIV/0!

*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.